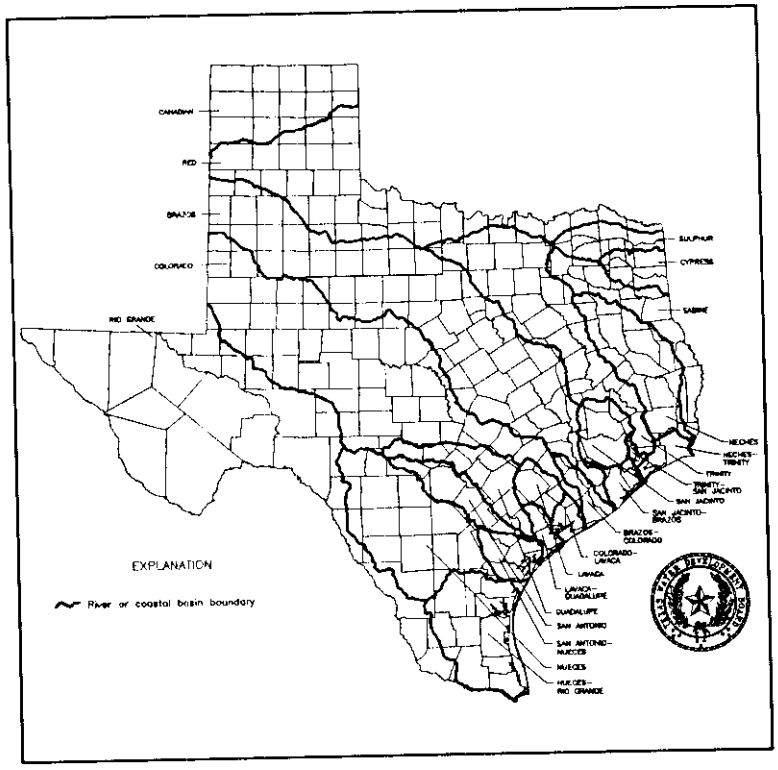
PROJECTED RIVER BASIN DEMANDS, SUPPLIES AND FACILITY NEEDS

As specified in Chapter 16.051 of the Texas Water Code, the Texas Water Development Board is also required to "define and designate river basins and watersheds as separate units ..." for consideration in planning, projection of in-basin water demands and supply needs, and contemplation of inter-basin water transfers.

As discussed in Section 2, various planning and modeling considerations were made in the water supply allocation studies for the State's river basins, including enhanced conservation practices, limits on ground-water availability, reservoir releases for instream flows and bays and estuaries needs, and other water management issues and techniques.



It was projected that ground-water supplies would be limited in many areas to a "safe yield" volume of pumpage and use to avoid de-watering of the aquifer(s) and the adverse side-effects of intense pumpage in sensitive aquifer areas. It was also determined that various agricultural water demands could not be economically met by replacing ground water supplies for irrigation with relatively expensive surface water supplies.

Both in-basin demands and out-of-basin export demands were projected to determine the total demand for a particular basin's water resources. The total demands on the basin's resources were then compared against available current water supplies from in-basin resources and imported water supplies.

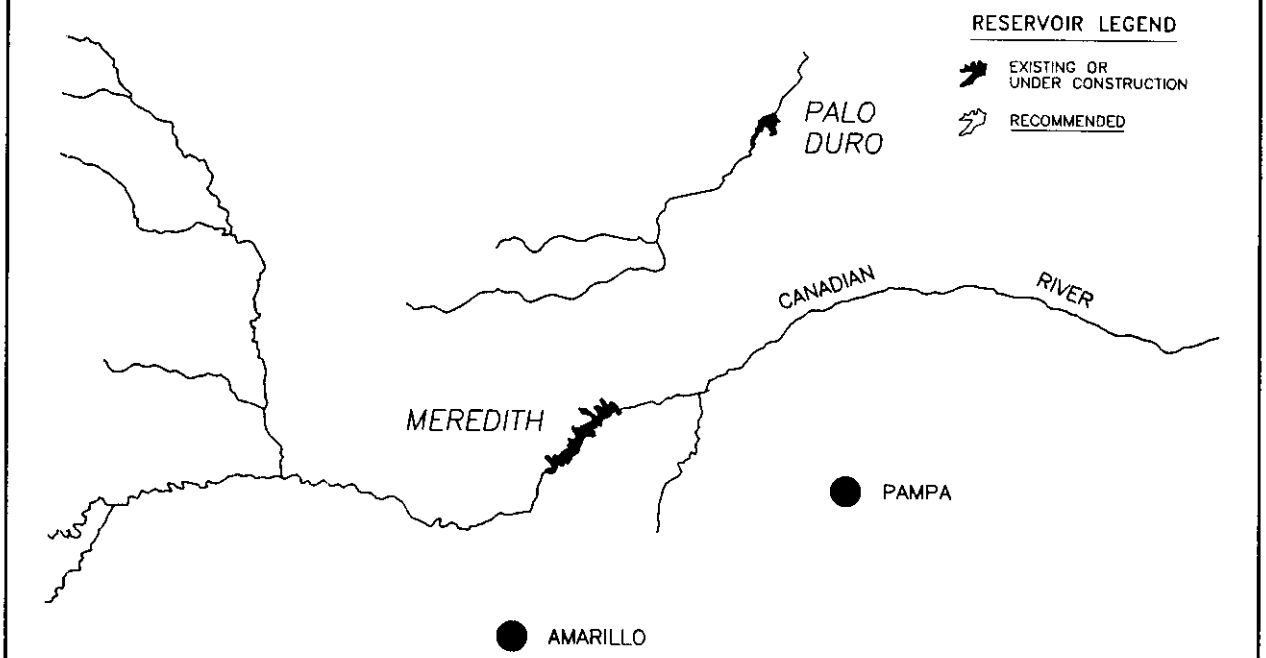
In general, where supply shortages existed for non-agricultural water use sectors and the development of sufficient additional ground-water resources was not feasible, further surface water supplies were projected to be made available from new reservoir projects, new conveyance systems from existing reservoirs, additional supply imports from other river basins, or from additional water reuse or use of return flows.

The Board's water allocation results for each basin are shown in the lower left-hand inset box of each basin "data sheet" description that follows in this section. The percent distribution of current and projected water demands and supplies are shown in the lower right portion.

Also shown is a schematic of the river and its major tributaries, existing major water supply reservoirs, recommended new supply projects, and the years' 2000 and 2040 estimated supplies and uses of those projects. Not shown are reservoirs whose substantive use involves non-consumptive activities (i.e., recreation, fish and wildlife enhancement, hydropower generation purposes, etc.). Current and projected future use of major and selected minor aquifers are also provided.

Summary data on demands, supplies, features and problems of the eight smaller Texas coastal basins follows the discussion of the major river basins. Further detail on individual municipalities, utilities, service areas, project status, and water, wastewater, or flood protection problems and needs can be found in the regional and local sections following the river and coastal basin discussion in Section 3.

CANADIAN RIVER BASIN



Projected Supply and Use of Major Water Supply Reservoirs
(acre-feet/year)

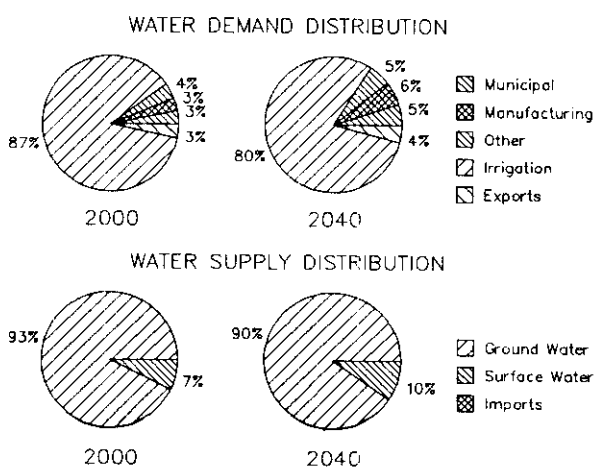
Reservoir	2000 Supply	2000 Use	2040 Supply	2040 Use
Meredith	74,350	51,894	62,550	61,470
Palo Duro	4,800	0	4,800	4,080

Projected Use of Major and Selected Minor Aquifers
(acre-feet/year)

Aquifer	2000 Use	2040 Use
Ogallala (High Plains)	744,570	802,050

PROJECTED WATER DEMANDS AND SUPPLIES
(acre-feet/year)

ITEM	2000	2040
IN-BASIN DEMAND		
Municipal	41,269	53,908
Manufacturing	37,735	60,004
Steam Electric	23,000	30,000
Mining	4,947	5,202
Irrigation	1,127,340	855,811
Livestock	21,676	21,676
Total In-Basin Demands	1,255,967	1,026,601
IN-BASIN SUPPLIES		
Ground Water	1,223,041	968,513
Surface Water	83,479	77,784
Total In-Basin Supplies	1,306,520	1,046,297
TRANSFERS		
Import Supplies	0	0
Export Demands	43,225	44,459
ADDITIONAL NEW SUPPLIES	12,657	24,810
AGRICULTURAL SHORTAGE	0	(1,753)
NET AVAILABILITY	19,985	1,800



Basin Description. The Canadian River Basin is located in the northern portion of the Texas Panhandle and consists of all or part of 15 counties (see Figure 1-4). The economy of the basin is based on agriculture, oil and gas production, agribusiness, manufacturing, and retail and wholesale trade. In 1980, the population of the basin totaled 167,500 people. Currently, the population of the basin is estimated at 171,800 residents, representing an increase of 2.6 percent from the 1980 population. By the year 2040, the basin population is projected to range between 225,300 and 257,200 residents. Major population centers in the basin include the Cities of Amarillo, Pampa, Borger, Dumas, Perryton, Dalhart, Spearman, Canadian, and Stinnett.

Current Water Uses. Total annual water use in the basin is currently 1,299,574 acre-feet. Water for irrigation purposes is the largest water demand category in the basin with a current use of 1,203,182 acre-feet. Other major water demands on the basin supplies are exports for use in other basins, municipal, and manufacturing water use.

Current Water Supplies. The basin is supplied primarily by ground water from the large multi-state Ogallala Aquifer, which ranges in saturated thickness from 20 to 540 feet, but is realizing long-term declining water level trends. Yields of large capacity wells average about 700 gallons per minute (gpm) and locally can produce up to 1,200 gpm. The City of Amarillo operates well fields in Carson, Randall, and Deaf Smith counties. Other aquifers in the basin include the Rita Blanca and the Dockum.

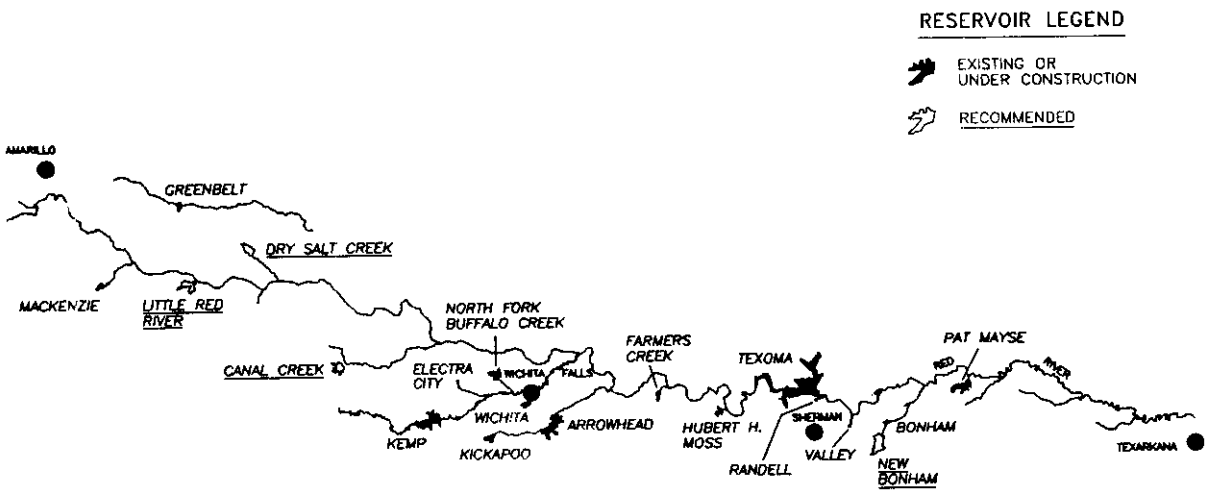
There are three major reservoirs located in the basin, of which two are water-supply reservoirs. Lake Meredith, constructed by the Bureau of Reclamation and operated by the Canadian River Municipal Water Authority, supplies water within the basin to the Cities of Borger and Pampa. The Authority also supplies water to the City of Amarillo, located partially in the Red River Basin; Plainview, Lubbock, Levelland, Slaton, Tahoka, and O'Donnell in the Brazos River Basin; and Brownfield and Lamesa in the Colorado River Basin. The 44,977 acre Lake Meredith Recreational Area is a unit of the National Park Service, managed by the NPS under a cooperative agreement with the U.S. Bureau of Reclamation. There is a proposal in Congress to designate it a National Recreation Area, although in any case, Lake Meredith is operated to conserve the recreational feature of the unit. Lake Palo Duro, currently under construction, will provide water to the member cities of the Palo Duro River Authority. Rita Blanca Lake, constructed by the U.S. Soil Conservation Service, is operated by Dallam and Hartley Counties for recreational purposes.

Current Water Quality. Major surface water quality problems in the basin are the high dissolved salt and solids concentrations (400 mg/l chloride levels and total dissolved solids (TDS) ranging from 1,000 mg/l and higher) in Lake Meredith. Domestic discharge of wastewater is made directly into Rita Blanca Lake, and as a result, the lake has experienced algal blooms, increased pH levels, and winter fish kills. The quality of the Ogallala Aquifer is generally good, although some areas of the aquifer in this basin have fluoride concentrations that exceed regulatory standards while other areas are experiencing saline intrusion as higher quality water supplies are withdrawn.

Future Water Uses. The basin's current water use pattern is not anticipated to change significantly over the 50-year planning period, with irrigation water needs continuing to be the major water use category of the basin. The reduction in irrigation water requirements is reflective of the expected improvements and implementation of more efficient water use irrigation equipment and management practices. With implementation of municipal water conservation programs and practices, annual savings of municipal water in the basin is projected to reach about 3,049 acre-feet by the year 2000, increasing further to about 8,868 acre-feet by 2040.

Future Water Supplies. Due to the scarcity of locally-developable surface water supplies, any additional supplies needed for the basin will likely come from reuse of present supplies and development of additional well fields in the Ogallala. In areas of current salinity problems, continued or expanded use of the aquifer could result in additional saline-water encroachment. It is estimated that by 2040 about 24,810 acre-feet per year of the basin needs will be supplied by reuse. Assuming additional water resources development in New Mexico, the long-range estimate of supplies from Lake Meredith is about 60 percent of the permitted diversion. This is the subject of a Supreme Court lawsuit with Texas and Oklahoma seeking to prevent New Mexico from even further depleting Canadian River flows in alleged violation of the interstate compact. Also, in order to insure the continued suitability of water from Lake Meredith for municipal and manufacturing purposes, the salinity control project proposed by the Bureau of Reclamation near Logan, New Mexico needs to be constructed.

RED RIVER BASIN



Projected Supply and Use of Major Water Supply Reservoirs
(acre-feet/year)

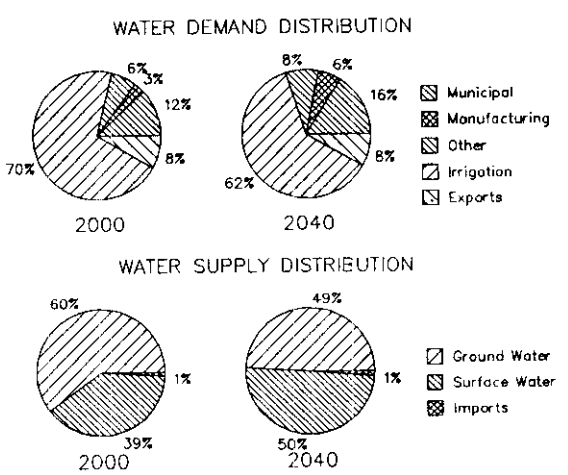
Reservoir	2000 Supply	2000 Use	2040 Supply	2040 Use
N.F. Buffalo Creek	1,120	1,120	1,120	1,120
Mackenzie	5,200	1,702	5,200	5,171
Greenbelt	9,400	4,614	7,886	5,794
Kemp	116,000	70,027	108,700	70,027
Electra City	600	108	600	593
Kickapoo	21,000	10,965	20,200	18,100
Arrowhead	41,000	22,264	37,000	36,852
Farmers Creek	4,500	1,198	4,500	1,753
Hubert Moss	6,300	2,563	5,500	5,497
Texoma	147,500	93,267	147,500	144,220
Randell	5,280	5,024	5,280	5,280
Valley	10,000	6,383	10,000	6,383
Bonham	7,240	1,544	4,850	3,951
New Bonham	0	0	93,800	53,391
Pat Mayse	58,900	17,071	58,600	32,518

Projected Use of Major and Selected Minor Aquifers
(acre-feet/year)

Aquifer	2000 Use	2040 Use
Ogallala (High Plains)	638,284	468,929
Seymour	54,357	47,952
Blaine	20,629	22,737
Trinity	2,895	2,985
Carrizo-Wilcox	40	40
Woodbine	5,348	5,414

PROJECTED WATER DEMANDS AND SUPPLIES
(acre-feet/year)

ITEM	2000	2040
IN-BASIN DEMAND		
Municipal	122,477	172,191
Manufacturing	26,866	60,907
Steam Electric	18,500	43,500
Mining	1,478	901
Irrigation	719,269	664,947
Livestock	45,949	45,949
Total In-Basin Demands	934,539	988,395
IN-BASIN SUPPLIES		
Ground Water	728,096	555,447
Surface Water	468,175	467,008
Total In-Basin Supplies	1,196,271	1,022,455
TRANSFERS		
Import Supplies	12,208	15,002
Export Demands	85,898	164,211
ADDITIONAL NEW SUPPLIES	1,000	95,300
AGRICULTURAL SHORTAGE	(8,147)	(139,915)
NET AVAILABILITY	197,189	24,766



Basin Description. The Red River Basin is bounded on the north by the Canadian River Basin and on the south by the Brazos, Trinity, and Sulphur River basins (see Figure 1-4). The economy of the area is based on agriculture, oil and gas production, agribusiness, manufacturing, and retail and wholesale trade. The population of the basin totaled about 506,000 people in 1980. Total population of the basin is currently estimated at 533,400 residents, representing an increase of about five percent above the 1980 population. The basin population is projected to range between 817,500 and 944,800 residents by the year 2040. The major population centers of the basin include the Cities of Amarillo, Wichita Falls, Texarkana, Sherman, Paris, Denison, Hereford, Vernon, Canyon, and Burkburnett.

Current Water Uses. Total annual water use supplied by water resources available to the basin is currently 948,101 acre-feet. Irrigation is the largest water demand in the basin with a current use of 770,592 acre-feet. Other major water demand categories in the basin include municipal and livestock water use.

Current Water Supplies. Over 60 percent of the basin needs are supplied by ground water from eight aquifers underlying the basin. From upper basin to lower basin these aquifers include the Ogallala, Dockum, Seymour, Blaine, Trinity, Woodbine, Blossom, and Nacatoch.

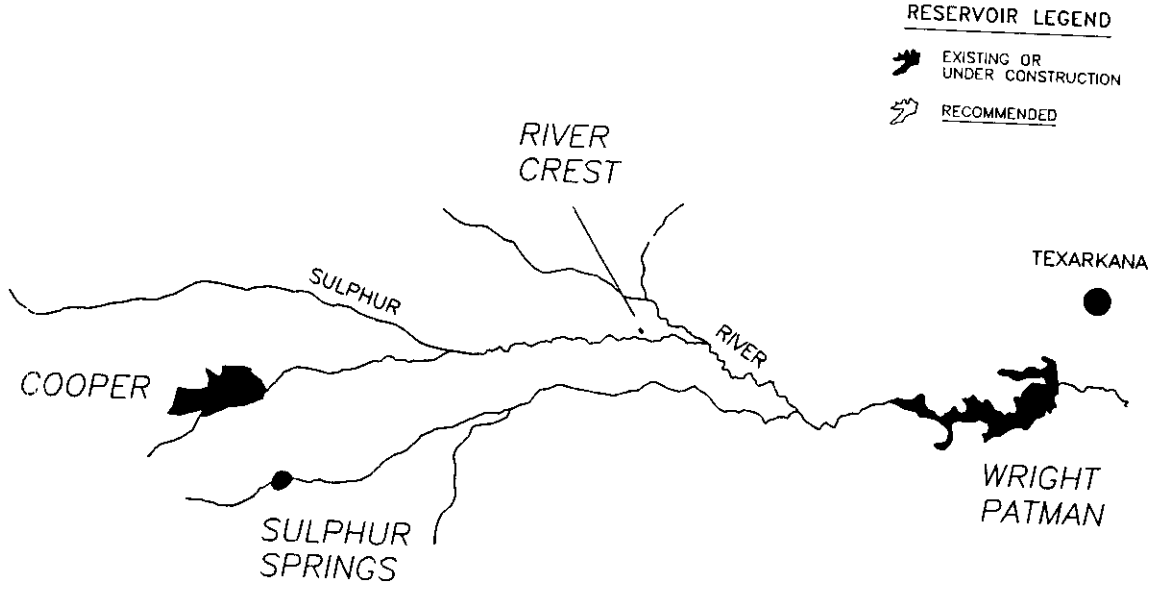
There are 23 major reservoirs in the Red River Basin of which 14 are water-supply reservoirs that have the potential to supply over 441,240 acre-feet per year of surface water to in-basin and out-of-basin users. In terms of major basin imports or exports, portions of the City of Amarillo receive imports from the Canadian River Municipal Water Authority in the upper basin while Lake Texoma in the middle Red River Basin provides exports to the North Texas Municipal Water District in the adjacent Trinity Basin.

Current Water Quality. Under low flow conditions, excessive concentrations of dissolved solids, sulfates, and chlorides are a general problem in most streams of the basin. During these low flow conditions in the upper basin, dissolved solids frequently exceed 25,000 mg/l concentrations, primarily arising from salt springs and seeps. Solids concentrations generally remain high until intervening flows into and below Lake Texoma reduce solids level to 1,000 mg/l or less. Ground-water quality is generally good (less than 1,000 mg/l TDS) in the Ogallala, Seymour, and Trinity aquifers in the upper, middle and lower Red River Basin, respectively, although salinity has increased locally in areas of high pumpage in the Ogallala and in downdip and eastern portions of the Trinity. Ground water in the Woodbine and Nacatoch aquifers in the eastern part of the basin contain generally less than 1,000 mg/l TDS, while the Blaine and Blossom aquifers in the west-central and eastern portions of the basin have TDS levels ranging from 500 to more than 5,000 mg/l.

Future Water Uses. The current water use pattern of the basin is not anticipated to change significantly over the 50-year planning period, as irrigation is projected to remain the major water demand category of the Red River Basin. Although irrigation water requirements are projected to account for a significant portion of the basin's future water requirements, improvements and implementation of more water use efficient irrigation equipment and management practices are projected to reduce irrigation water demands in the basin through the year 2040. Additionally, implementation of municipal water use conservation programs and practices are projected to reduce annual municipal water use by more than 9,555 acre-feet by the year 2000 and by about 29,573 acre-feet by the year 2040 below the Board's without-conservation forecast.

Future Water Supplies. In the future, some cities that are currently on ground water will have to convert to surface water supplies that have already been developed in the basin. Also, some of the smaller communities with ground-water problems will have to develop surface water projects that are considered local in nature (less than 1,000 acre-feet capacity). The only planned major water supply reservoir is the New Bonham Project, which will supply 93,800 acre-feet per year of surface water to the North Texas Municipal Utility District for use in the Dallas area. Construction of the federal chloride control project, including the Canal Creek, Little Red River, and Dry Salt Creek diversion lakes, is also recommended to improve water quality and expand future useable supplies.

SULPHUR RIVER BASIN



Projected Supply and Use of Major Water Supply Reservoirs
(acre-feet/year)

Reservoir	2000 Supply	2000 Use	2040 Supply	2040 Use
Cooper	122,000	42,051	122,000	99,988
Sulphur Springs	7,800	5,415	7,800	7,784
River Crest	10,000	1,500	10,000	1,500
Wright Patman	180,000	74,872	180,000	136,283

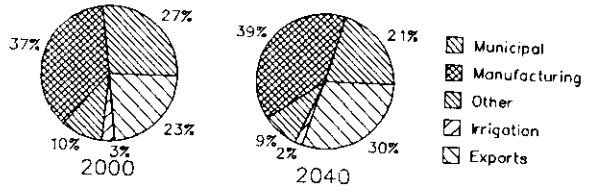
Projected Use of Major and Selected Minor Aquifers
(acre-feet/year)

Aquifer	2000 Use	2040 Use
Carrizo-Wilcox	4,205	4,350
Trinity	858	748
Nacatoch	1,005	912
Woodbine	820	884
Blossom	512	158

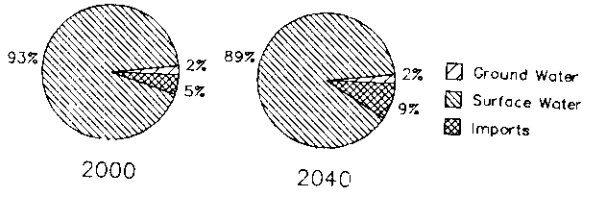
PROJECTED WATER DEMANDS AND SUPPLIES
(acre-feet/year)

ITEM	2000	2040
IN-BASIN DEMAND		
Municipal	43,263	61,560
Manufacturing	58,481	116,509
Steam Electric	6,500	16,500
Mining	587	455
Irrigation	4,804	4,804
Livestock	8,825	8,825
Total In-Basin Demands	122,460	208,653
IN-BASIN SUPPLIES		
Ground Water	7,665	7,521
Surface Water	331,843	331,349
Total In-Basin Supplies	339,508	338,870
TRANSFERS		
Import Supplies	16,997	32,388
Export Demands	38,963	89,220
ADDITIONAL NEW SUPPLIES AGRICULTURAL SHORTAGE	0 (880)	0 (880)
NET AVAILABILITY	195,962	74,265

WATER DEMAND DISTRIBUTION



WATER SUPPLY DISTRIBUTION



Basin Description. The Sulphur River Basin is bounded on the north by the Red River Basin, on the west by the Trinity River Basin, on the south by the Sabine and Cypress River Basins, and on the east by the Texas-Arkansas border (see Figure 1-4). The economy of the area is based on agriculture, agribusiness, manufacturing, retail and wholesale trade, and government. The 1980 basin population totaled 154,000 people. Currently, the basin population is estimated at about 163,300 residents, representing an increase of about seven percent above the 1980 population. By the year 2040, the basin population is projected to range between 246,700 and 293,600 residents. The major population centers in the basin include the Cities of Texarkana, Paris, Sulphur Springs, Commerce, Atlanta, New Boston, Clarksville, Wake Village, Nash, and Mount Vernon.

Current Water Uses. Total annual water use supplied by the basin's water resources is currently 90,405 acre-feet. The largest water use categories within the basin are for manufacturing and municipal purposes with a combined total use of 76,197 acre-feet. Other major water demands are irrigation and livestock water use.

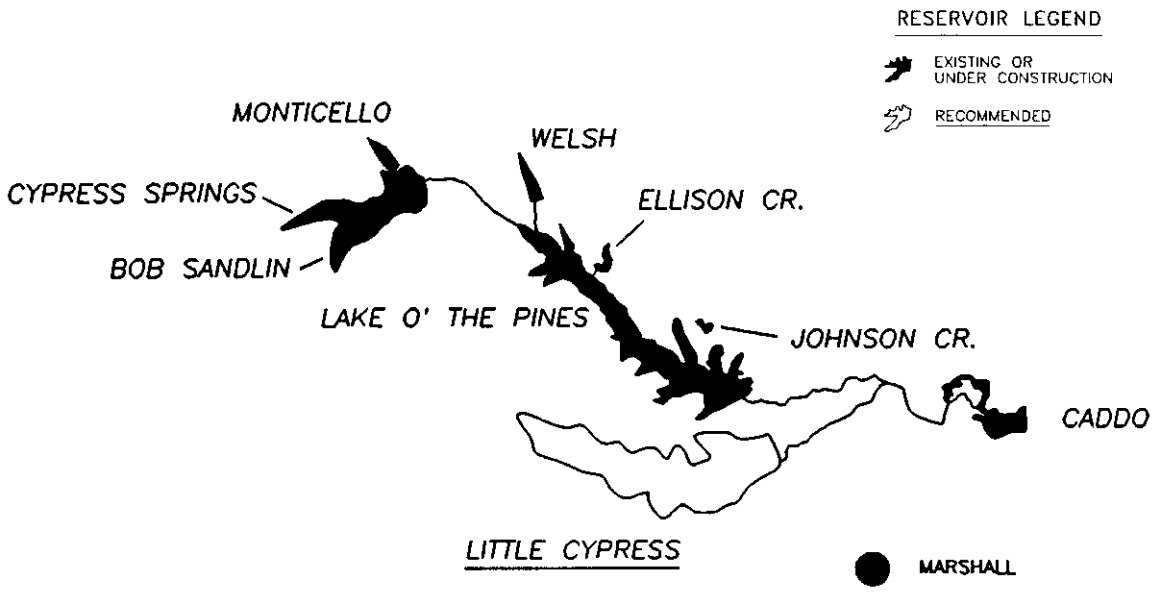
Current Water Supplies. There are three major water-supply reservoirs in the Sulphur Basin and one under construction. Currently, two reservoirs (Lake Sulphur Springs and Lake Wright Patman) are capable of supplying over 187,800 acre-feet per year and are meeting most of the surface-water needs of the basin. Cooper Lake, presently under construction, will provide 122,000 acre-feet per year of surface water to the City of Irving, the North Texas Municipal Water District and the Sulphur River Municipal Water District. In addition, major ground-water supplies are available from the Carrizo-Wilcox Aquifer with lesser supplies occurring in the Trinity, Woodbine, Blossom, Nacatoch, and Queen City aquifers.

Current Water Quality. Generally, both surface and ground-water supplies are of relatively good quality. In the South Sulphur River and Days Creek, municipal wastewater discharges, during low flow conditions, have caused problems of low dissolved oxygen, elevated fecal coliform counts, and elevated nutrients. While the concentrations of TDS are generally less than 500 mg/l, iron concentrations are a problem locally in the Queen City and Carrizo-Wilcox aquifers. Saline encroachment is a potential problem with localized heavy withdrawals from the Woodbine, Nacatoch, and Blossom aquifers. Locally, the concentration of fluoride in the Woodbine, Nacatoch, and Blossom aquifers exceeds the Interim Primary Drinking Water Standards.

Future Water Uses. The current water use pattern of the basin is expected to change over the 50-year planning period as export demand is projected to become the second largest demand on the basin's water supply by the year 2040. In-basin municipal and manufacturing water requirements are projected to account for about 60 percent of the basin's total water requirements for the same year. With implementation of municipal water conservation programs and practices, annual savings in municipal water are projected to reach about 3,509 acre-feet by the year 2000, increasing further to about 10,862 acre-feet by the year 2040.

Future Water Supplies. No additional projects are proposed for this basin; however, if the Board's water demand forecasts are too low due to conservation goals not being obtained, even more rapid growth being realized than projected by the Board, or certain projects recommended for development in other basins cannot be constructed, there are additional sites, such as Parkhouse 1 and 2 and Marvin Nichols 1 and 2, within this basin that could be developed to meet future water-supply needs in other basins.

CYPRESS RIVER BASIN



Projected Supply and Use of Major Water Supply Reservoirs
(acre-feet/year)

Reservoir	2000 Supply	2000 Use	2040 Supply	2040 Use
Cypress Springs	16,200	2,613	16,200	4,534
Monticello	7,700	7,700	7,700	7,700
Bob Sandlin	48,500	4,234	48,500	31,375
Welsh	13,100	13,100	13,100	13,100
Ellison Creek	22,100	22,100	22,100	22,100
Johnson Creek	6,700	3,000	6,700	6,700
Lake O' The Pines	130,800	59,808	130,800	65,161
Little Cypress	0	0	129,000	85,078
Caddo	10,000	6,515	10,000	0

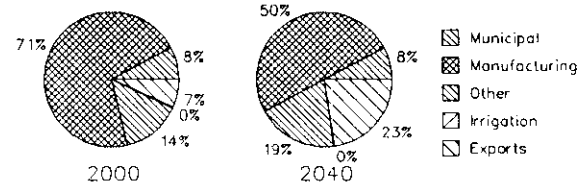
Projected Use of Major and Selected Minor Aquifers
(acre-feet/year)

Aquifer	2000 Use	2040 Use
Carrizo-Wilcox	14,323	11,104
Queen City	3,014	13,197

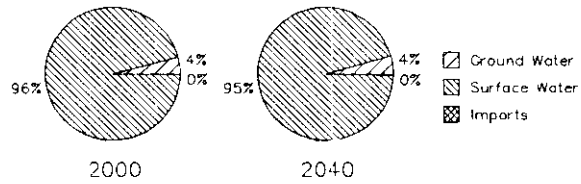
PROJECTED WATER DEMANDS AND SUPPLIES
(acre-feet/year)

ITEM	2000	2040
IN-BASIN DEMAND		
Municipal	22,525	32,317
Manufacturing	204,165	207,277
Steam Electric	35,000	63,500
Mining	1,529	11,523
Irrigation	1,154	1,154
Livestock	4,670	4,670
Total In-Basin Demands	269,043	320,441
IN-BASIN SUPPLIES		
Ground Water	17,337	24,301
Surface Water	259,698	250,167
Total In-Basin Supplies	277,035	274,468
TRANSFERS		
Import Supplies	26	1,743
Export Demands	19,170	93,802
ADDITIONAL NEW SUPPLIES	146,984	276,034
AGRICULTURAL SHORTAGE	0	0
NET AVAILABILITY	135,832	138,002

WATER DEMAND DISTRIBUTION



WATER SUPPLY DISTRIBUTION



Basin Description. The Cypress River Basin is bounded on the north by the Sulphur River Basin, on the west and south by the Sabine River Basin, and on the east by the Texas-Arkansas and Texas-Louisiana borders (see Figure 1-4). The economy of the area is based on manufacturing, agriculture, agribusiness, retail and wholesale trade, and mineral production. Population of the basin totaled about 118,200 people in 1980. Currently, the total basin population is estimated at 125,500 residents, representing an increase of about six percent above the 1980 basin population. By the year 2040, population of the basin is projected to range between 200,500 and 230,900 residents. Major population centers within the Cypress River Basin include the Cities of Marshall, Mount Pleasant, Atlanta, Gilmer, Pittsburg, Winnsboro, Daingerfield, Hughes Springs, Linden, and Waskom.

Current Water Uses. Total annual water use within the basin is currently 200,961 acre-feet. The largest water using category is manufacturing with current use of 145,093 acre-feet. Other major water demands placed on the basin's water resources are steam-electric power generation, municipal, and exports for use in other basins.

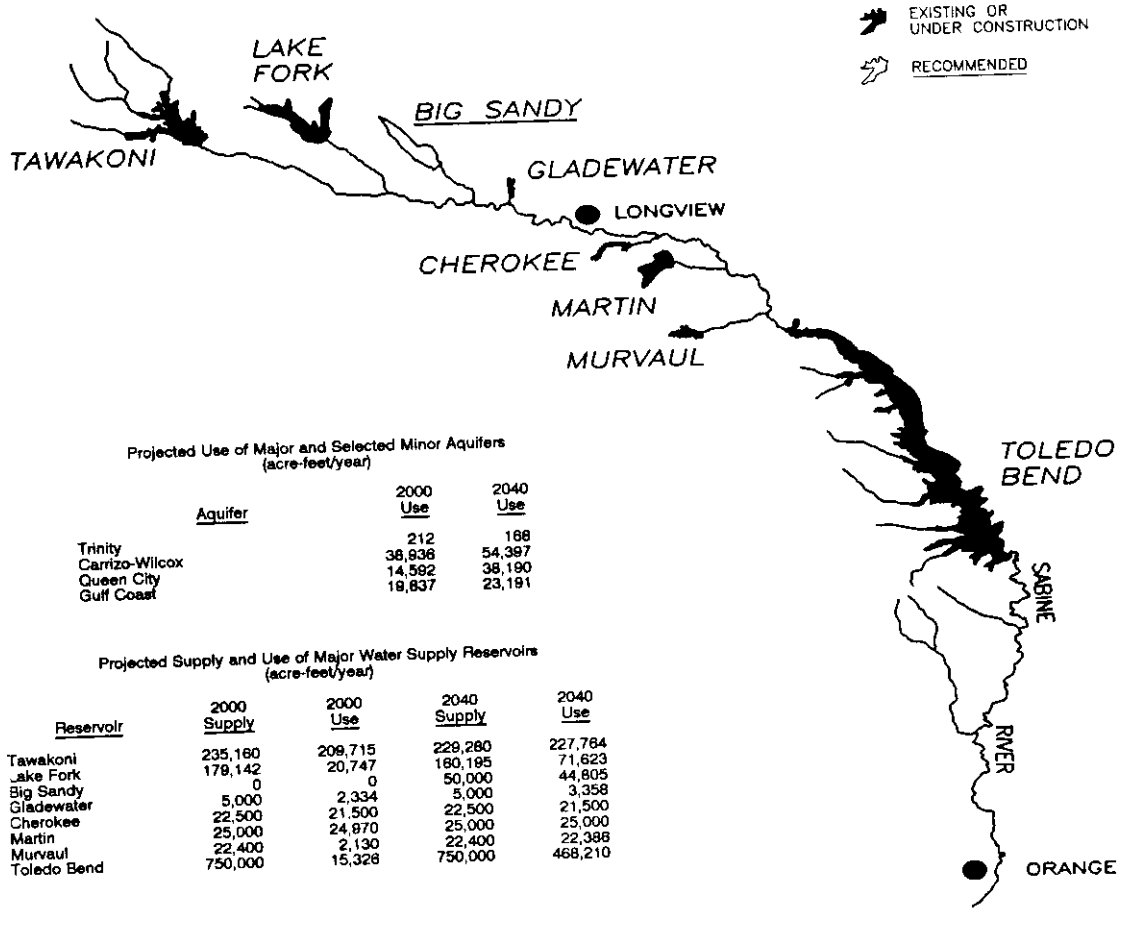
Current Water Supplies. The Cypress River Basin is one of the most developed basins in the State for its size. There are eight major water-supply reservoirs in this 2,812 square mile basin which can supply a total of 254,900 acre-feet per year of water. Most of this supply is used for industrial purposes and steam-electric power generation. The majority of groundwater supplies is obtained from the Carrizo-Wilcox Aquifer with lesser amounts supplied from the Queen City Aquifer.

Current Water Quality. Surface water is generally of good quality, although streams in the Cypress Basin periodically exhibit low dissolved oxygen concentrations sometimes caused by point source wastewater discharges and compounded by sluggish stream velocities and low reaeration rates. Groundwater quality of the Carrizo-Wilcox is generally good, although supplies from the shallow water-bearing sands of the Carrizo-Wilcox and the Queen City aquifers often have high iron levels and high acidity values. Local declines in artesian pressure in the Carrizo-Wilcox Aquifer presents potential problems in the basin, especially saline encroachment.

Future Water Uses. The current water use pattern of the Cypress River Basin is anticipated to change over the 50-year planning period as exports become the second largest demand on the basin's water supply by the year 2040. Manufacturing water requirements are projected to account for about 50 percent of the basin's total water requirements by the end of the planning period. With implementation of municipal water conservation programs and practices, annual savings of municipal water in the basin is projected to reach 1,819 acre-feet by the year 2000, and about 5,688 acre-feet by the year 2040.

Future Water Supplies. Approximately 147,000 acre-feet per year of future needs will be met through reuse by the year 2040, primarily for steam-electric power generation and industrial water uses. In addition, the Little Cypress Utility District has received a permit to construct the Little Cypress Reservoir. When complete, this reservoir will supply 129,000 acre-feet per year of surface water to meet the future needs within this basin, a portion of the Sabine River Basin, and possibly the City of Shreveport, Louisiana. Environmental considerations related to impacts of potential significant lowering of Caddo Lake levels through expanded water supply use, especially during dry weather periods, preclude it being a viable site for future water supplies in the Board's forecasts. The Northeast Texas Municipal Water District has requested that the Corps of Engineers perform a reallocation study of flood control storage to water supply storage on Lake O' The Pines.

SABINE RIVER BASIN



Projected Use of Major and Selected Minor Aquifers
(acre-feet/year)

Aquifer	2000 Use	2040 Use
Trinity	212	188
Carrizo-Wilcox	38,936	54,397
Queen City	14,592	38,190
Gulf Coast	19,837	23,191

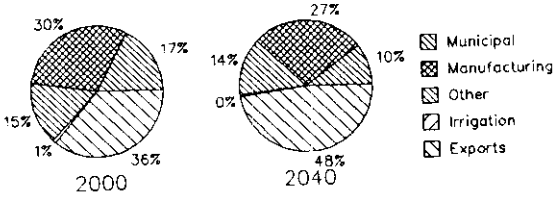
Projected Supply and Use of Major Water Supply Reservoirs
(acre-feet/year)

Reservoir	2000 Supply	2000 Use	2040 Supply	2040 Use
Tawakoni	235,160	209,715	229,280	227,784
Lake Fork	179,142	20,747	180,195	71,623
Big Sandy	0	0	50,000	44,805
Gladewater	5,000	2,334	5,000	3,358
Cherokee	22,500	21,500	22,500	21,500
Martin	25,000	24,970	25,000	25,000
Murvaul	22,400	2,130	22,400	22,388
Toledo Bend	750,000	15,328	750,000	468,210

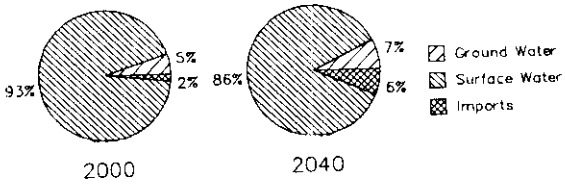
PROJECTED WATER DEMANDS AND SUPPLIES
(acre-feet/year)

ITEM	2000	2040
IN-BASIN DEMAND		
Municipal	93,710	129,895
Manufacturing	165,414	348,573
Steam Electric	65,000	141,000
Mining	6,531	29,484
Irrigation	5,555	5,555
Livestock	12,005	12,005
Total In-Basin Demands	348,215	666,512
IN-BASIN SUPPLIES		
Ground Water	73,658	116,137
Surface Water	1,336,803	1,310,014
Total In-Basin Supplies	1,410,461	1,426,151
TRANSFERS		
Import Supplies	23,217	101,580
Export Demands	197,014	608,870
ADDITIONAL NEW SUPPLIES	0	50,000
AGRICULTURAL SHORTAGE	0	0
NET AVAILABILITY	888,449	302,349

WATER DEMAND DISTRIBUTION



WATER SUPPLY DISTRIBUTION



Basin Description. The Sabine River Basin in Texas is bounded on the north by the Sulphur and the Cypress River Basins, on the west by the Trinity and Neches River Basins, and on the east by the Texas-Louisiana border (see Figure 1-4). The economy of the area is based on manufacturing, agriculture, agribusiness, mineral production, retail and wholesale trade, and recreation. In 1980, the population of the basin totaled about 407,300 people. Currently, the basin population is estimated at 456,000 residents, representing an increase of 12 percent above the 1980 population. By the year 2040, the basin population is projected to range between 734,200 and 848,500 residents. Major population centers in the Sabine River Basin include the Cities of Longview, Greenville, Orange, Marshall, Kilgore, Bridge City, and Gladewater.

Current Water Uses. Total annual water use is currently 249,650 acre-feet. The largest demand placed on the basin's water resources is for exports to other basins currently estimated at over 112,000 acre-feet. Other major water demands in the basin include manufacturing, municipal, and steam-electric power generation.

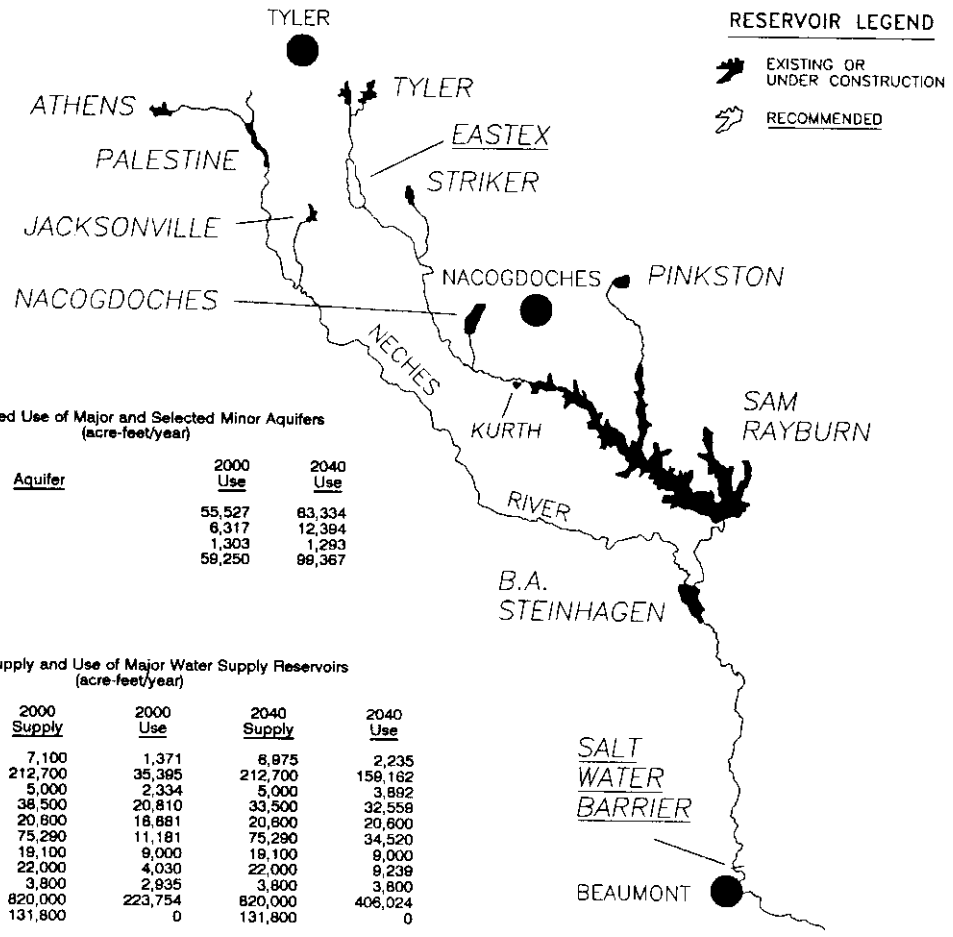
Current Water Supplies. The surface water within the Sabine River Basin was apportioned between the States of Louisiana and Texas by the Sabine River Compact in 1954. Of the 12 major reservoirs in the Texas portion of the basin, five are used for recreation and flood regulation. The remaining seven reservoirs supply about 1,245,450 acre-feet per year of surface water to users within the basin and in portions of the Neches, Sulphur, and Trinity River Basins. Ground water is obtained from the Carrizo-Wilcox, Nacatoch, Trinity, Queen City, Sparta, and Gulf Coast aquifers. Other basin water-supply issues include flooding and drainage, environmental conflicts, and conflicts over local use versus out-of-basin use.

Current Water Quality. While limited areas of the basin exhibit salinity problems in surface water supplies, current surface water quality is generally good. In the past, the Sabine River has experienced frequent dissolved oxygen violations, although improved wastewater treatment has greatly improved river water quality. Generally, dissolved solids concentrations in the Gulf Coast, Carrizo-Wilcox, Sparta and Queen City aquifers are below 1,000 mg/l, while ground water in portions of the Trinity and Nacatoch exhibit relatively higher salinity. Ground water contained in the shallow water-bearing sands of the Carrizo-Wilcox and Queen City aquifers often have high concentrations of iron and acidity. Saline water encroachment and land surface subsidence are potential problems in the basin due to heavy withdrawals of ground water from the Gulf Coast Aquifer in the lower part of the basin.

Future Water Uses. The current water use pattern of the basin is not anticipated to change significantly over the 50-year planning period, as export demand is expected to remain the major water demand on the basin's water supplies. Manufacturing and municipal water requirements are projected to account for about 37 percent of the basin's total water requirements by the year 2040. Annual municipal water savings, through implementation of municipal water conservation programs and practices, are projected to reach about 7,506 acre-feet by the year 2000, increasing further to about 22,713 acre-feet by the year 2040.

Future Water Supplies. To meet future needs, additional ground water will need to be developed, primarily for mining and steam-electric power generation. The Big Sandy Reservoir Project will need to be constructed to supply 50,000 acre-feet per year of surface water to meet municipal and manufacturing needs in the upper basin. At the present time, the acceptance of a federal non-development easement precludes the implementation of the potential Waters Bluff Reservoir Project in the upper basin. This potentially precedent-setting easement (see Federal/State Relations portion of Section 4) has been litigated, and the easement upheld. An appeal to this decision may be filed. Depending upon the outcome of this possible action, the Waters Bluff Reservoir may be a viable site for future water supplies. Depending upon the degree of water conservation savings that can be obtained in the Houston area, between 336,000 and 513,000 acre-feet per year of surface water will need to be exported from Toledo Bend Reservoir to the San Jacinto River Basin to meet the outstanding future needs in the Houston area that are not met with other supplies. Also, existing surface water supply in Lake Fork Reservoir under contract to Dallas is projected to be made available for its use through construction of major conveyance facilities between 2010 to 2030.

NECHES RIVER BASIN



Projected Use of Major and Selected Minor Aquifers
(acre-feet/year)

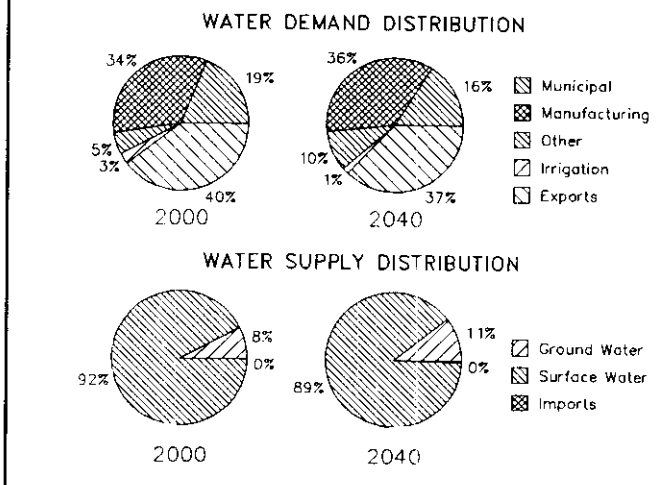
Aquifer	2000 Use	2040 Use
Carrizo-Wilcox	55,527	63,334
Queen City	6,317	12,394
Sparta	1,303	1,293
Gulf Coast	59,250	99,367

Projected Supply and Use of Major Water Supply Reservoirs
(acre-feet/year)

Reservoir	2000 Supply	2000 Use	2040 Supply	2040 Use
Athens	7,100	1,371	6,975	2,235
Palestine	212,700	35,395	212,700	159,162
Jacksonville	5,000	2,334	5,000	3,892
Lake Tyler	38,500	20,810	33,500	32,558
Striker	20,600	16,881	20,600	20,600
Eastex	75,290	11,181	75,290	34,520
Kurth	19,100	9,000	19,100	9,000
Nacogdoches	22,000	4,030	22,000	9,239
Pinkston	3,800	2,935	3,800	3,800
Sam Rayburn	820,000	223,754	820,000	406,024
Steinhagen	131,800	0	131,800	0

PROJECTED WATER DEMANDS AND SUPPLIES
(acre-feet)

ITEM	2000	2040
IN-BASIN DEMAND		
Municipal	111,900	161,441
Manufacturing	198,441	358,441
Steam Electric	17,000	78,000
Mining	3,772	8,308
Irrigation	15,064	15,064
Livestock	11,397	11,397
Total In-Basin Demands	357,574	632,651
IN-BASIN SUPPLIES		
Ground Water	127,048	181,753
Surface Water	1,445,849	1,442,895
Total In-Basin Supplies	1,572,897	1,624,648
TRANSFERS		
Import Supplies	1,413	4,888
Export Demands	234,538	373,341
ADDITIONAL NEW SUPPLIES	75,290	75,290
AGRICULTURAL SHORTAGE	(71)	(336)
NET AVAILABILITY	1,057,559	699,170



Basin Description. The Neches River Basin is bounded on the north and east by the Sabine River Basin, on the west by the Trinity River Basin, and on the south by the Neches-Trinity Coastal Basin (see Figure 1-4). The economy of the area is based on manufacturing, forestry, agriculture, agribusiness, oil and gas production, and retail and wholesale trade. The population of the basin totaled about 506,400 people in 1980. The current population of the basin is estimated at 553,400 residents, representing an increase of about nine percent above the 1980 basin population. The basin population is projected to range between 930,100 and 1,076,100 residents by the year 2040. Major population centers within the basin include the Cities of Beaumont, Tyler, Port Arthur, Lufkin, Nacogdoches, Palestine, Nederland, Groves, Port Neches, and Jacksonville.

Current Water Uses. Total annual water use in the basin is currently 298,293 acre-feet. The largest water demands in the basin are for manufacturing and municipal purposes with a combined use of 242,279 acre-feet. Other major water demands placed on the basin's water supplies are exports for use in other basins and irrigation.

Current Water Supplies. There are ten major water-supply reservoirs in the basin. These projects, along with run-of-the-river flows, are capable of supplying 1,281,400 acre-feet per year of dependable surface water supplies. Several of the reservoirs provide water to cities out of the basin. Lake Athens provides water to the City of Athens in the Trinity River Basin. Lake Pinkston provides water to the City of Center located in the Sabine River Basin. Over 53 percent of Lake Palestine is owned by the City of Dallas in the Trinity River Basin and will be needed by the Dallas utility before 2010.

Ground water from the Carrizo-Wilcox, Queen City, Sparta, and Gulf Coast aquifers is used to meet about 40 percent of the current needs of the basin. Localized ground-water declines are a problem in some areas of the basin.

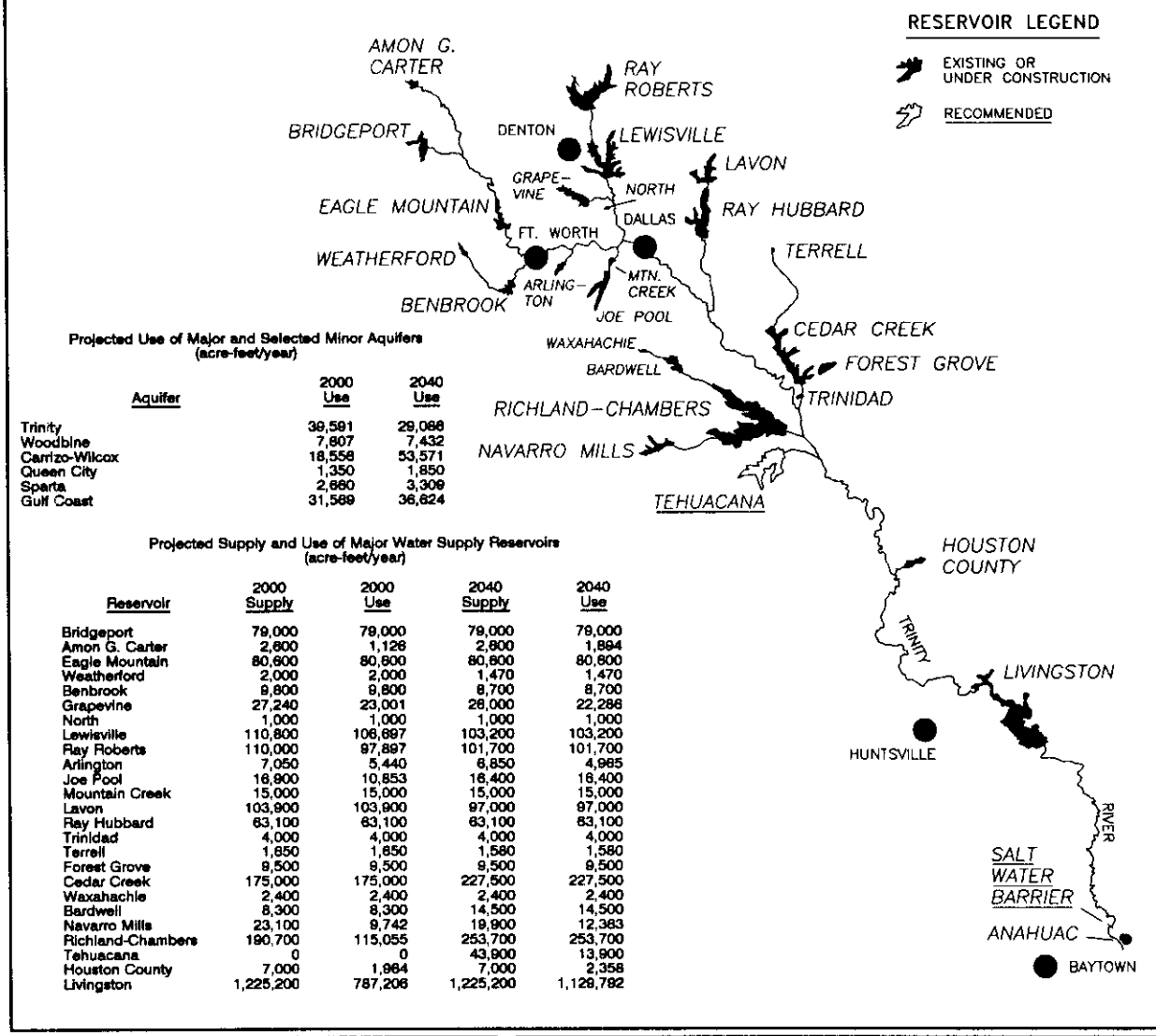
Other water supply-related problems in the basin include environmental concerns associated with the Big Thicket and other bottomland hardwood habitats, and salt water intrusion in the tidally-influenced reaches of the Neches River.

Current Water Quality. Surface water quality in the basin is generally excellent, although localized areas of higher salinity from oil field run-off are present. Poorer stream quality in the form of low dissolved oxygen and pH may result in the headwaters of Sam Rayburn Reservoir, on the Angelina River, and the Neches River, upstream of Lake Palestine during low flow conditions due to municipal and industrial discharges. In the tidal portion of the basin, reduced waste loadings have substantially improved water quality. Water quality from the Carrizo-Wilcox, Gulf Coast, Queen City, and Sparta aquifers is generally good (less than 500 mg/l TDS), although salinity may increase downdip and high iron and acid concentrations may be present in the shallow water-bearing sands of the Carrizo-Wilcox and Queen City formations.

Future Water Uses. The current water use pattern of the basin is not expected to change significantly over the 50-year planning period, as export demand and manufacturing water requirements are projected to account for about 73 percent of the basin's total water requirements by the year 2040. With implementation of municipal water conservation programs and practices, annual savings in municipal water are projected to reach 8,997 acre-feet by the year 2000, and about 28,328 acre-feet by the year 2040.

Future Water Supplies. In the future, the total quantity of ground water use will increase, but will comprise less than 30 percent of the total water use in the basin. The Angelina and Neches River Authority has received a permit to construct the Eastex Reservoir Project on Mud Creek. This project could supply 75,290 acre-feet per year to municipal and manufacturing entities currently on ground water that may choose to convert to surface water in the future and provide for future additional steam-electric and manufacturing water uses. A salt water barrier is also recommended on the lower Neches River to protect municipal and industrial water supplies in the lower basin from sea water intrusion.

TRINITY RIVER BASIN



Projected Use of Major and Selected Minor Aquifers (acre-feet/year)

Aquifer	2000 Use	2040 Use
Trinity	39,591	29,086
Woodbine	7,807	7,432
Carrizo-Wilcox	18,558	53,571
Queen City	1,350	1,850
Sparta	2,660	3,309
Gulf Coast	31,589	36,624

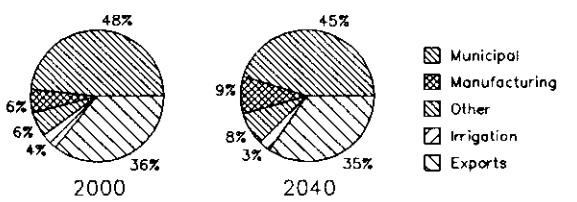
Projected Supply and Use of Major Water Supply Reservoirs (acre-feet/year)

Reservoir	2000 Supply	2000 Use	2040 Supply	2040 Use
Bridgeport	79,000	79,000	79,000	79,000
Amon G. Carter	2,600	1,126	2,600	1,884
Eagle Mountain	80,600	80,600	80,600	80,600
Weatherford	2,000	2,000	1,470	1,470
Benbrook	8,800	8,800	8,700	8,700
Grapevine	27,240	23,001	26,000	22,286
North	1,000	1,000	1,000	1,000
Lewisville	110,800	106,697	103,200	103,200
Ray Roberts	110,000	97,897	101,700	101,700
Arlington	7,050	5,440	6,850	4,985
Joe Pool	18,900	10,853	18,400	18,400
Mountain Creek	15,000	15,000	15,000	15,000
Lavon	103,900	103,900	97,000	97,000
Ray Hubbard	63,100	63,100	63,100	63,100
Trinidad	4,000	4,000	4,000	4,000
Terrell	1,650	1,650	1,580	1,580
Forest Grove	9,500	9,500	9,500	9,500
Cedar Creek	175,000	175,000	227,500	227,500
Waxahachie	2,400	2,400	2,400	2,400
Bardwell	8,300	8,300	14,500	14,500
Navarro Mills	23,100	9,742	19,900	12,383
Richland-Chambers	190,700	115,055	253,700	253,700
Tehuacana	0	0	43,900	13,900
Houston County	7,000	1,964	7,000	2,358
Livingston	1,225,200	787,206	1,225,200	1,128,792

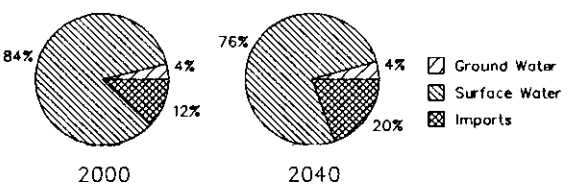
PROJECTED WATER DEMANDS AND SUPPLIES (acre-feet/year)

ITEM	2000	2040
IN-BASIN DEMAND		
Municipal	1,054,835	1,425,568
Manufacturing	126,356	290,918
Steam Electric	81,300	147,800
Mining	20,262	76,491
Irrigation	86,095	89,039
Livestock	30,296	30,296
Total In-Basin Demands	1,399,144	2,060,112
IN-BASIN SUPPLIES		
Ground Water	105,398	145,880
Surface Water	2,324,595	2,271,142
Total In-Basin Supplies	2,429,993	2,417,022
TRANSFERS		
Import Supplies	339,843	639,639
Export Demands	785,465	1,090,877
ADDITIONAL NEW SUPPLIES	2,000	203,900
AGRICULTURAL SHORTAGE	0	0
NET AVAILABILITY	587,227	109,572

WATER DEMAND DISTRIBUTION



WATER SUPPLY DISTRIBUTION



Basin Description. The Trinity Basin is bounded on the north by the Red River Basin, on the east by the Sabine and Neches basins, and on the west by the Brazos and San Jacinto basins (see Figure 1-4). The economy is based on manufacturing, finance, services, transportation, and agribusiness. Basin population in 1980 totaled 3.2 million people. The current basin population is about 4.1 million (a 28 percent increase since 1980) and should reach between 6.8 and 7.7 million residents by 2040. Major population centers include Dallas and Fort Worth, their suburban areas, and the cities of Huntsville, and Corsicana.

Current Water Uses. Total basin annual water use is currently 1,049,721 acre-feet. Due to the large population, municipal water use is, by far, the largest basin demand with a current annual use of 820,967 acre-feet. Other major water demands on the basin's supplies are exports for other basins, manufacturing, and irrigation.

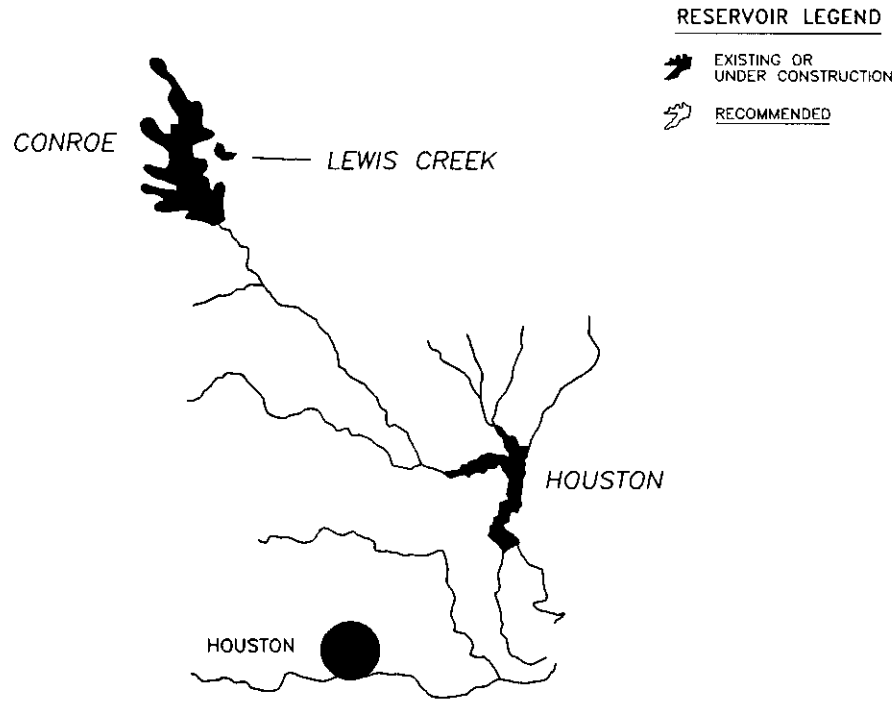
Current Water Supplies. Twenty-four of the 30 major basin reservoirs are for water supply, providing over 2,281,300 acre-feet per year. Lake Livingston, containing over 50 percent of the basin's surface water supply, provides water to Houston and users in coastal basins. Major suppliers in the upper basin are the Dallas Water Utilities, Tarrant County WCID No. 1, and North Texas Municipal Water District (NTMWD). Ground-water supplies are obtained from seven aquifers, including the Trinity, Woodbine, Carrizo-Wilcox, Gulf Coast, Queen City, Sparta, and Nacatoch aquifers. Water supply problems include poor stream and ground-water quality in portions of the basin, water-level declines and depletion of storage in the aquifers, flooding and drainage, concern for wetlands and the Trinity-San Jacinto Estuary, and salt water intrusion in the lower reaches of the Trinity River.

Current Water Quality. Surface water quality varies widely from the cleaner headwaters of the basin to the more effluent-dominated, nutrient-rich waters below the Dallas-Ft. Worth metroplex. Elevated levels of ammonia, nitrogen, and phosphorus with resulting increases in biochemical demand (which causes depressed dissolved oxygen concentrations), fecal coliform, and volatile suspended solids have been prevalent in the upstream reaches in past years during dry periods when flow is effluent-dominated. This historic problem has been much reduced given today's improved wastewater treatment levels. However, depressed oxygen levels and elevated fecal coliform levels are observed in the upper Trinity during rise events in the river stage following significant rainfall, an indication of non-point source pollution problems. Water quality in the Trinity and Gulf Coast aquifers in the upper and lower basin, respectively, ranges from fresh to slightly saline. Water quality in the Queen City, Sparta, and Nacatoch aquifers is generally good (TDS levels below 500 mg/l), while water in the Woodbine Aquifer is relatively poor (TDS levels in excess of 1,500 mg/l). Potential saline encroachment problems exist in the Trinity and Gulf Coast aquifers due to a decline in artesian pressure.

Future Water Uses. The basin's current water use pattern should not change significantly over the next 50 years, as municipal use is projected to remain the basin's major water demand. With implementation of municipal conservation practices, annual water use savings should reach 84,860 acre-feet by 2000, increasing to more than 250,113 acre-feet by 2040.

Future Water Supplies. Ground-water use should decline in the upper basin as cities convert to surface water, while in the central and lower basin, ground-water use should increase. By 2040, about six percent of surface water needs will be supplied by reuse, primarily for steam electric and industrial purposes. A diversion of Trinity River supplies that will allow expanded use of the existing Richland-Chambers and Cedar Creek reservoirs and construction of the new Tehuacana Reservoir is recommended for Tarrant County WCID No. 1 to meet its future supply needs. These projects and system-wide operations will provide over 190,000 acre-feet per year of new supplies, adequate to meet the District's needs beyond 2040. If the Trinity diversion is built, but projected conservation savings are not attained, the District could obtain further supplies by participating in the Parkhouse II or Marvin Nichols reservoirs in the Sulphur Basin. Should the Trinity diversion be infeasible, new supplies from a Marvin Nichols reservoir may be required. The NTMWD will need to construct the New Bonham project in the Red Basin which would provide an additional 93,800 acre-feet of annual supplies. Should the Board's conservation savings not be realized, there would be a need for participation in the Parkhouse II or Marvin Nichols reservoirs. New pipelines from Palestine and Lake Fork reservoirs should provide the Dallas area with adequate surface water supplies through 2040. Parkhouse I Reservoir would be needed by Dallas by 2030 if the Board's predicted conservation savings are not realized. With construction of a salt water barrier in the lower basin, current supplies will be more than adequate to meet future needs of the central and lower Trinity Basin. Additionally, the Tennessee Colony project, if feasible financing were arranged and environmental impacts were acceptable, could provide improved flood protection for the lower basin.

SAN JACINTO RIVER BASIN



Projected Supply and Use of Major Water Supply Reservoirs
(acre-feet/years)

Reservoir	2000 Supply	2000 Use	2040 Supply	2040 Use
Houston	144,600	144,600	130,900	130,900
Lewis Creek	6,300	4,301	6,300	4,301
Conroe	98,200	83,710	91,000	91,000

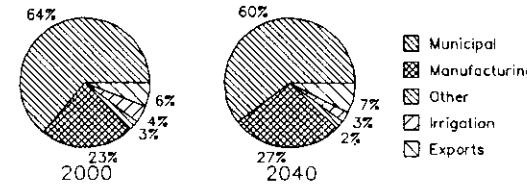
Projected Use of Major and Selected Minor Aquifers
(acre-feet/year)

Aquifer	2000 Use	2040 Use
Gulf Coast	237,756	226,622

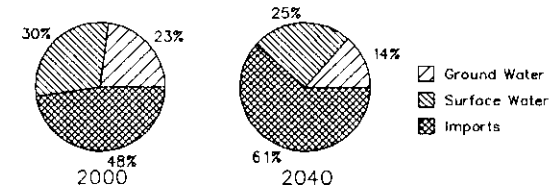
PROJECTED WATER DEMANDS AND SUPPLIES
(acre-feet/year)

ITEM	2000	2040
IN-BASIN DEMAND		
Municipal	656,021	1,010,203
Manufacturing	237,773	460,049
Steam Electric	20,500	27,500
Mining	5,131	5,634
Irrigation	44,850	44,242
Livestock	3,004	3,004
Total In-Basin Demands	967,279	1,550,632
IN-BASIN SUPPLIES		
Ground Water	237,756	226,622
Surface Water	307,164	287,792
Total In-Basin Supplies	544,920	514,414
TRANSFERS		
Import Supplies	495,003	1,028,987
Export Demands	60,000	125,561
ADDITIONAL NEW SUPPLIES	0	130,887
AGRICULTURAL SHORTAGE	(3,745)	(3,904)
NET AVAILABILITY	16,389	1,999

WATER DEMAND DISTRIBUTION



WATER SUPPLY DISTRIBUTION



Basin Description. The San Jacinto River Basin is bounded on the north and east by the Trinity River Basin and the Trinity-San Jacinto Coastal Basin, on the west by the Brazos River Basin, and on the south by the San Jacinto-Brazos Coastal Basin (see Figure 1-4). The economy of the basin is based on manufacturing, finance, services, retail and wholesale trade, agriculture, commercial shipping, commercial fishing, and tourism. The 1980 basin population totaled 2.37 million people. Currently, the total basin population is estimated at 2.75 million residents, representing an increase of about 16 percent since 1980. By the year 2040, population of the San Jacinto Basin is projected to range between 4.8 and 5.6 million residents. The major population centers within the basin include the Cities of Houston, Pasadena, Baytown, Missouri City, Huntsville, Deer Park, Conroe, South Houston, Bellaire, and West University Place.

Current Water Uses. Total annual water use in the basin is currently 738,531 acre-feet. Due to the large basin population, municipal water use is the largest water demand in the basin with a current use of 498,550 acre-feet. Other major water demands placed on the basin's water resources are manufacturing, exports for use in other basins, and irrigation.

Current Water Supplies. About 42 percent of the basin's available supply is ground water from the Gulf Coast Aquifer and is used for municipal, manufacturing, and agricultural purposes. However, the area within the Harris-Galveston Coastal Subsidence District has been given a mandate to convert to between 80 to 90 percent surface water usage by 2010. There are six major reservoirs in the basin of which three are water-supply reservoirs. Lake Conroe, owned and operated by the San Jacinto River Authority, provides municipal and manufacturing water supplies to the City of Houston. Water is also diverted from Lake Conroe to Lewis Creek Reservoir for steam-electric power generation. Lake Houston is owned and operated by the City of Houston for use in its service area. The San Jacinto River Authority also holds water rights to flows in the San Jacinto River. Surface water from the Trinity River Basin is delivered into the basin by the Coastal Water Authority.

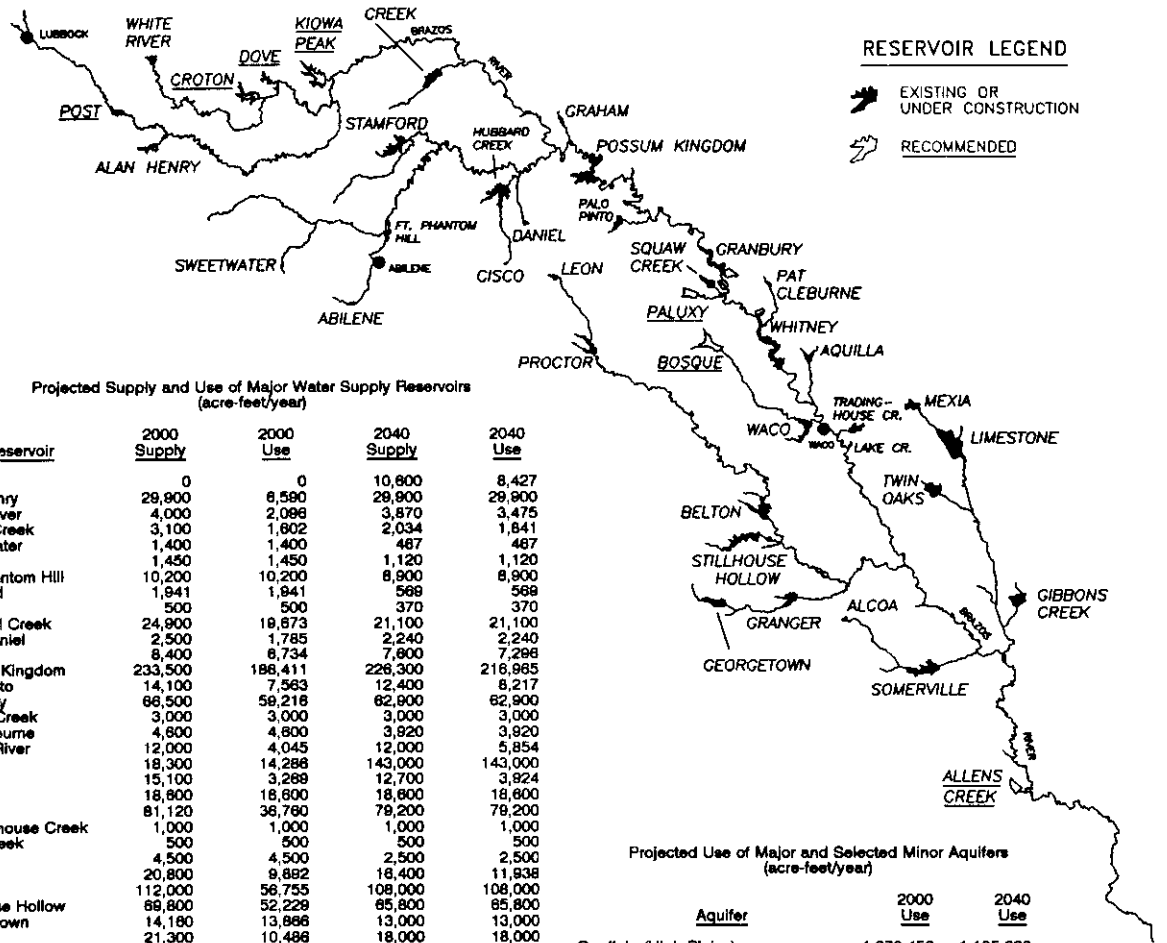
Water-supply problems in the basin include land-surface subsidence due to overdraft of ground water, poor quality ground and surface water, flooding, and environmental concerns for wetlands and the Trinity-San Jacinto Estuary.

Current Water Quality. The basin exhibits wide variations in surface water quality. As the Houston metroplex expands to the north, small wastewater treatment plants increase the organic and nutrient loading and fecal coliform bacteria levels in all major tributaries to Lake Houston. Buffalo Bayou, which drains most of the City of Houston, receives heavy municipal, industrial, and urban stormwater runoff loading. During periods of low flow, low dissolved oxygen and elevated fecal coliform levels are common. Over the past years, water quality in Buffalo Bayou and the Houston Ship Channel has improved due to reduced waste loads, and aquatic and/or marine organisms are inhabiting areas where few had previously been found. Ground water in the Gulf Coast Aquifer generally contains less than 500 mg/l. Land surface subsidence, saline water encroachment, and surface fault activation have occurred as a result of heavy pumpage and corresponding declines in artesian pressure.

Future Water Uses. The current water use pattern of the San Jacinto River Basin is not expected to change significantly over the 50-year planning period, as water requirements for municipal and manufacturing purposes are projected to remain the dominant water using categories within the basin. With implementation of municipal water conservation programs and practices, annual savings in the basin's municipal water are projected to reach 52,905 acre-feet by the year 2000, and increasing further to 177,638 acre-feet by the year 2040.

Future Water Supplies. The basin will need new supplies in the future. Almost all of the additional supplies will be imported into the basin from the Sabine and Trinity River Basins, which will require the development of a major conveyance facility from the Sabine River to either the Trinity River or to terminal storage within the San Jacinto Basin. The development of a salt water barrier on the Trinity River will make surplus supplies in the Trinity River Basin available for export to the San Jacinto River Basin. In addition, by 2040 over 65,200 acre-feet per year of the total water used in the basin will be supplied by the reuse of the supplies for the City of Houston. If the Toledo Bend diversion or diversions from the Trinity River prove infeasible, Lake Creek Reservoir, southwest of Conroe, could be used to meet water demands in the basin. A small local project, Spring Creek Lake, could provide supplemental municipal water supplies to The Woodlands area and Montgomery County.

BRAZOS RIVER BASIN



Projected Supply and Use of Major Water Supply Reservoirs
(acre-feet/year)

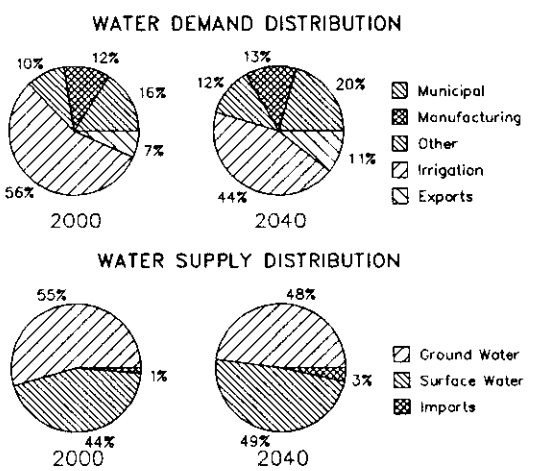
Reservoir	2000 Supply	2000 Use	2040 Supply	2040 Use
Post	0	0	10,600	8,427
Alan Henry	29,900	6,590	29,900	29,900
White River	4,000	2,096	3,870	3,475
Millers Creek	3,100	1,602	2,034	1,641
Sweetwater	1,400	1,400	467	467
Abilene	1,450	1,450	1,120	1,120
Fort Phantom Hill	10,200	10,200	8,900	8,900
Stamford	1,941	1,941	568	568
Cisco	500	500	370	370
Hubbard Creek	24,900	19,673	21,100	21,100
Lake Daniel	2,500	1,785	2,240	2,240
Graham	8,400	6,734	7,600	7,298
Possum Kingdom	233,500	186,411	226,300	216,985
Palo Pinto	14,100	7,563	12,400	8,217
Granbury	66,500	59,218	62,900	62,900
Squaw Creek	3,000	3,000	3,000	3,000
Pat Cleburne	4,600	4,600	3,920	3,920
Paluxy River	12,000	4,045	12,000	5,854
Whitney	18,300	14,288	143,000	143,000
Aquilla	15,100	3,269	12,700	3,924
Bosque	18,600	18,600	18,600	18,600
Waco	81,120	36,760	79,200	79,200
Tradinghouse Creek	1,000	1,000	1,000	1,000
Lake Creek	500	500	500	500
Leon	4,500	4,500	2,500	2,500
Proctor	20,800	9,882	16,400	11,938
Belton	112,000	56,755	108,000	108,000
Stillhouse Hollow	69,800	52,229	65,800	65,800
Georgetown	14,180	13,866	13,000	13,000
Granger	21,300	10,486	18,000	18,000
Alcoa	9,000	9,000	9,000	9,000
Somerville	41,000	41,000	37,000	37,000
Mexia	3,000	1,211	100	100
Limestone	66,200	53,849	64,000	63,364
Twin Oaks	1,000	1,000	1,000	1,000
Gibbons Creek	1,000	1,000	1,000	1,000
Allens Creek	0	0	66,500	66,500

Projected Use of Major and Selected Minor Aquifers
(acre-feet/year)

Aquifer	2000 Use	2040 Use
Ogallala (High Plains)	1,279,459	1,105,628
Seymour	64,056	51,988
Trinity	27,518	28,239
Brazos River Alluvium	25,962	29,402
Edwards-Balcones	4,275	4,733
Carrizo-Wilcox	92,410	170,125
Gulf Coast	43,401	51,475

PROJECTED WATER DEMANDS AND SUPPLIES
(acre-feet/year)

ITEM	2000	2040
IN-BASIN DEMAND		
Municipal	417,488	657,865
Manufacturing	310,069	413,735
Steam Electric	167,100	263,600
Mining	18,674	58,156
Irrigation	1,489,439	1,411,868
Livestock	71,277	71,277
Total In-Basin Demands	2,474,047	2,876,501
IN-BASIN SUPPLIES		
Ground Water	1,556,437	1,462,146
Surface Water	1,161,750	1,118,008
Total In-Basin Supplies	2,718,187	2,580,154
TRANSFERS		
Import Supplies	41,273	106,418
Export Demands	179,937	345,771
ADDITIONAL NEW SUPPLIES	95,703	363,529
AGRICULTURAL SHORTAGE	(65,103)	(198,207)
NET AVAILABILITY	266,282	26,036



Basin Description. The Brazos River Basin is bounded on the north by the Red River Basin, on the east by the Trinity and San Jacinto river basins and the San Jacinto-Brazos Coastal Basin, and on the south and west by the Colorado River Basin and the Brazos-Colorado Coastal Basin (see Figure 1-4). The area economy is based on agriculture, agribusiness, manufacturing, mineral production, trades, services, and government. Basin population totaled 1.53 million people in 1980 while the current basin population is about 1.73 million (an increase of 13 percent since 1980). This is expected to increase to between 3.1 and 3.8 million residents by 2040. Major basin population centers include the Cities of Lubbock, Abilene, Waco, Temple-Killeen, Bryan-College Station, Round Rock-Georgetown-Cedar Park-Leander, Sugarland-Richmond-Rosenburg and the Brazosport area.

Current Water Uses. Total annual basin water use is currently 2,034,811 acre-feet. The largest demand placed on the basin's water resources is for irrigation with a current use of 1,427,645 acre-feet. Other major water demands on the basin's water resources are exports for use in other basins, municipal, manufacturing, and steam-electric power generation.

Current Water Supplies. Ground water from the Ogallala and Seymour aquifers supplies most water needs of the upper basin with lesser amounts supplied from the Edwards-Trinity and Dockum aquifers. The Trinity, Edwards-Balcones, and Carrizo-Wilcox aquifers provide most of the ground water in the central basin with lesser amounts from the Queen City, Sparta, and Brazos River Alluvium. The Gulf Coast Aquifer is used in the lower basin.

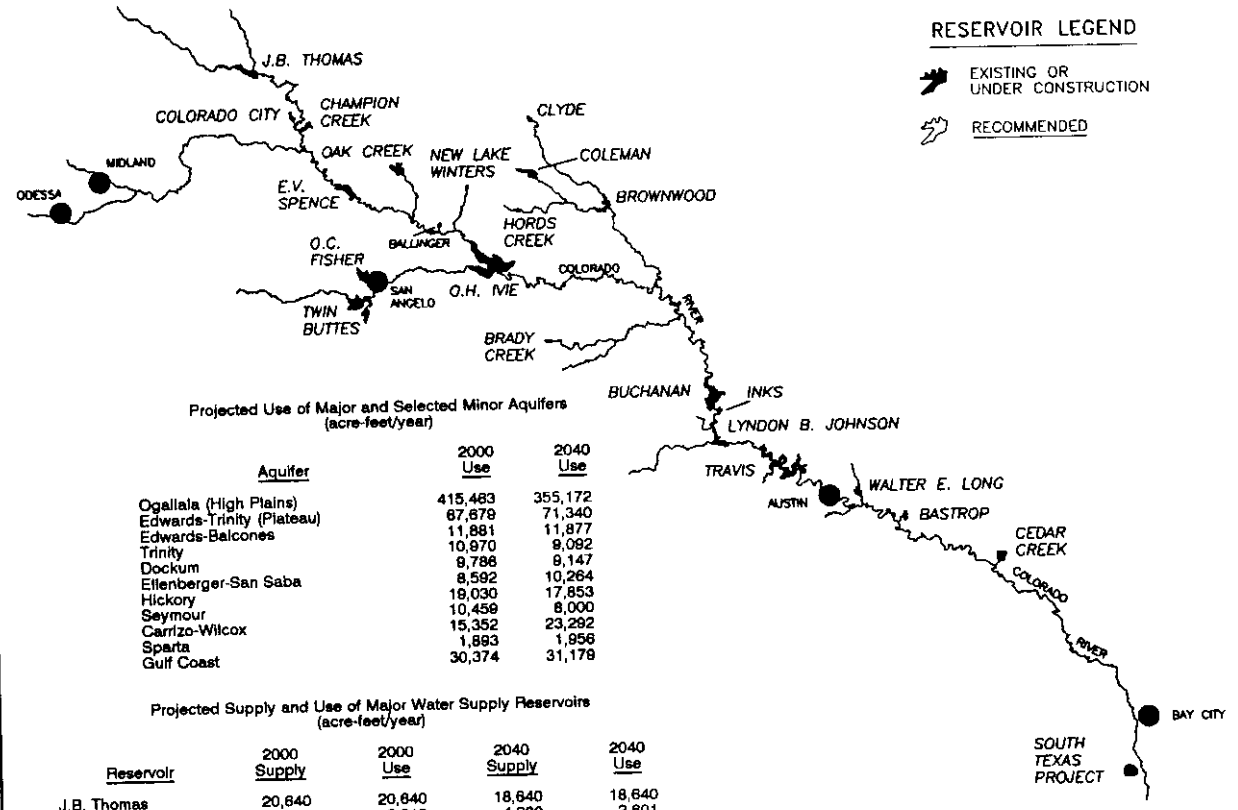
There are 33 major existing water supply reservoirs in the basin. Water is also imported from the Canadian and Colorado basins. The Brazos River Authority (BRA) owns, operates, or has acquired storage in 12 of the reservoirs as part of its basin-wide water system to supply water for in-basin uses and exports to the Trinity and San Jacinto-Brazos basins. Total basin surface water supplies are over 866,000 acre-feet per year.

Current Water Quality. In the many aquifers that traverse the basin, ground-water quality ranges from fresh (Ogallala, Trinity, Carrizo-Wilcox, Edwards, Brazos River Alluvium, and Gulf Coast aquifers) to more highly saline (downdip portions of previous aquifers, Seymour, and locally in the Brazos River Alluvium), with problems of salt water encroachment on both ground-water and surface water supplies present in portions of the upper and central basin. The basin's overall surface water quality is relatively good, but with localized areas of concern. Natural and man-made salt pollution in the upper basin adversely affect surface water quality and municipal supplies. Problems of low dissolved oxygen and elevated fecal coliform levels occasionally exist, during periods of low flow, in the areas of municipal wastewater point source discharges. Frequent elevated fecal coliform levels are a problem in the north Bosque River due to agricultural runoff from local dairy farms.

Future Water Uses. The current water use pattern of the basin is expected to change over the planning period, as municipal and manufacturing water requirements are projected to account for more than 33 percent of the basin water requirements by 2040. Irrigation water use is projected to account for about 44 percent of total basin requirements in 2040. With increased municipal water conservation programs and practices, annual savings are projected to reach 33,736 acre-feet per year by 2000, increasing further to nearly 115,863 acre-feet per year by 2040.

Future Water Supplies. While ground water will continue to provide most of the in-basin supply in the upper basin, two new reservoirs are needed. Lake Alan Henry, already under construction, and Post Reservoir, which already has been permitted, will be required to provide additional supplies to Lubbock. Declining water levels in the Trinity Aquifer have necessitated the planned conversion to surface water by cities in the central basin. The Bosque and Paluxy reservoir projects and the reallocation of storage in Lake Waco will be needed to provide additional surface water supplies. Due to the limited ground-water supplies in the Williamson County area, additional surface water will be needed from Lake Stillhouse Hollow and possibly from imports from the Colorado River Basin. In addition to the Bosque Reservoir Project and Lake Waco reallocation, the Allens Creek Project and the reallocation of storage in Lake Whitney will be needed to meet the future needs of the BRA system. These projects would supply the lower basin and provide for export to the San Jacinto-Brazos Coastal Basin. These new projects will provide a combined 236,000 acre-feet per year of additional surface water supplies. Reallocation of reservoir storage to water supply would affect some of the existing features of these projects, including flood control and water-based recreation. These would be considered in the permit evaluations. Also, pending the availability of federal and/or state financial support, three brine-retention reservoirs (Croton, Dove, and Kiowa Peak) are recommended for construction in the upper basin to reduce the salinity and improve water quality in several of the basin's reservoirs.

COLORADO RIVER BASIN



Projected Use of Major and Selected Minor Aquifers
(acre-feet/year)

Aquifer	2000 Use	2040 Use
Ogallala (High Plains)	415,483	355,172
Edwards-Trinity (Plateau)	67,679	71,340
Edwards-Balcones	11,881	11,877
Trinity	10,970	9,092
Dockum	9,786	9,147
Ellenberger-San Saba	8,592	10,264
Hickory	19,030	17,853
Seymour	10,459	8,000
Carrizo-Wilcox	15,352	23,292
Sparta	1,893	1,956
Gulf Coast	30,374	31,178

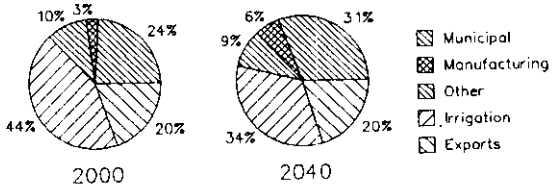
Projected Supply and Use of Major Water Supply Reservoirs
(acre-feet/year)

Reservoir	2000 Supply	2000 Use	2040 Supply	2040 Use
J.B. Thomas	20,640	20,640	18,640	18,640
Colorado City	5,500	2,019	4,280	2,601
Champion Creek	5,000	5,000	5,000	5,000
E.V. Spence	48,100	34,611	43,430	43,930
Oak Creek	4,800	4,180	4,400	4,400
New Lake Winters	1,160	952	1,160	920
Ballinger	1,800	1,142	1,800	1,335
O.C. Fisher	13,200	13,200	9,300	8,300
Twin Buttes	31,400	28,971	29,000	28,881
O.H. Ivie	113,000	5,401	101,000	57,937
Hords Creek	1,200	107	1,200	122
Clyde	760	697	440	440
Coleman	7,090	1,539	6,400	2,257
Brownwood	31,400	12,870	30,466	21,574
Brady Creek	3,100	3,098	3,100	3,100
Highland Lakes	445,268	135,629	445,266	417,361

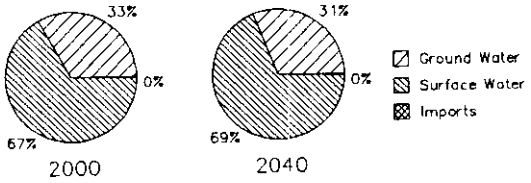
PROJECTED WATER DEMANDS AND SUPPLIES
(acre-feet/year)

ITEM	2000	2040
IN-BASIN DEMAND		
Municipal	353,859	546,757
Manufacturing	45,016	112,090
Steam Electric	74,000	104,100
Mining	36,428	26,447
Irrigation	649,578	602,285
Livestock	37,228	37,228
Total In-Basin Demands	1,196,109	1,428,907
IN-BASIN SUPPLIES		
Ground Water	638,482	582,647
Surface Water	1,274,386	1,258,149
Total In-Basin Supplies	1,912,868	1,840,796
TRANSFERS		
Import Supplies	2,858	4,387
Export Demands	292,979	363,267
ADDITIONAL NEW SUPPLIES	0	14,205
AGRICULTURAL SHORTAGE	(30,731)	(53,975)
NET AVAILABILITY	457,369	121,189

WATER DEMAND DISTRIBUTION



WATER SUPPLY DISTRIBUTION



Basin Description. The Colorado River Basin is bounded on the north and east by the Brazos River Basin, on the south and west by the Lavaca, Guadalupe, Nueces, and Rio Grande basins (see Figure 1-4). The economy is based on mineral production, agriculture, agribusiness, manufacturing, trades, and government. The 1980 basin population totaled 1.1 million people, increasing to a current level of 1.3 million (an increase of more than 18 percent). By 2040, the basin population is projected to range between 2.2 and 2.8 million. Major basin population centers include the Cities of Austin, Midland, Odessa, San Angelo, Big Spring, and Brownwood.

Current Water Uses. Total annual basin water use is currently 941,905 acre-feet. Irrigation water use is the largest demand placed on the basin's supplies with a current use of 561,184 acre-feet. Other major basin water demands are exports for use in other basins and municipal water use.

Current Water Supplies. Several aquifers provide water to the basin. The Ogallala, along with the Edwards-Trinity and Dockum aquifers, occur in the upper part of the basin. The Edwards-Trinity and Lipan aquifers are in the west-central part. Lowering of Edwards-Balcones water levels is of concern in areas in the central basin. The Trinity, Edwards-Balcones and Carrizo-Wilcox are in the south-central basin along with minor aquifers which include the Hickory, Ellenberger-San Saba, Marble Falls, Queen City, and Sparta aquifers. The Gulf Coast Aquifer occurs in the lower basin. Use of this aquifer raises concerns over related land subsidence and its attendant problems.

The basin has 26 major reservoirs, which along with the river flows below Austin, can provide over 1,203,380 acre-feet per year of supply. The Canadian River Municipal Water Authority provides water to Brownfield and Lamesa from Lake Meredith. Major suppliers in the basin are the Colorado River Municipal Water District (CRMWD), the Lower Colorado River Authority (LCRA), and irrigation companies in the lower part of the basin. The LCRA and irrigation companies export water to areas in the Brazos-Colorado, Colorado-Lavaca, and Lavaca basins. A study is underway to examine the feasibility of transfers from the Garwood Irrigation District in the Colorado Basin to Lake Texana in the Lavaca Basin. At the mouth of the Colorado, an under-construction river diversion would reestablish the historic flows of the Colorado River back into Matagorda Bay would provide for non-consumptive navigation and environmental water uses. Environmental water use benefits of this diversion are estimated by the Corps at over $9 million annually.

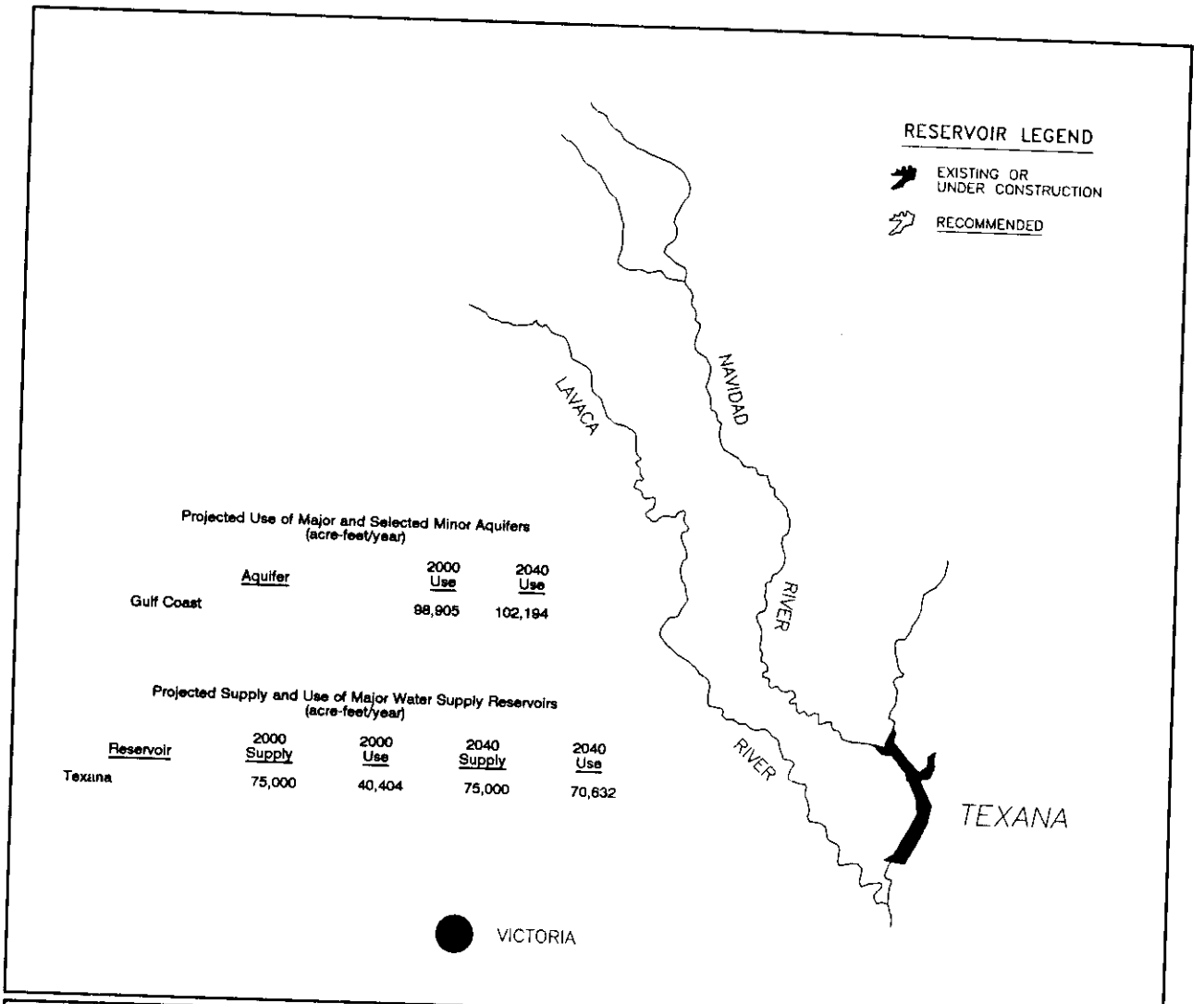
Current Water Quality. Surface water quality ranges from good to poor in the upper reaches of the basin primarily due to salinity intrusion from natural and man-made (primarily oil and gas development) sources. While a recent accidental spill of highly saline water, brought about by more than 80 inches of rain falling within the drainage area of a normally unproductive lake, has adversely affected riverine water quality, overall salinity control projects carried out by the CRMWD continue to significantly improve the riverine quality of the upper basin. The water quality of the Concho, Llano, and Pedernales rivers is excellent with sporadic dissolved oxygen and fecal coliform violations. Surface water quality below Austin has been poor due to wastewater discharges, although with recent upgrades and new construction of wastewater treatment facilities, the quality of the river below Austin is improving. Water quality in the many aquifers that traverse the basin ranges from fresh to highly saline.

While ground-water quality is good in many areas, high dissolved solids (Ogallala and Edwards-Trinity Aquifers) and fluoride (Ogallala) affect some ground-water supplies in the upper portions of the basin. High fluoride and nitrate levels in ground water in the upper basin currently exceed the Interim Primary Drinking Water Standards. In the lower basin, the Sparta and Queen City aquifers have generally high dissolved solids concentrations. Salinity in the Dockum Aquifer results from both natural poor quality and man-made contamination from oil field activities.

Future Water Uses. Current water use patterns of the Colorado Basin are expected to change over the next 50 years, as water use for irrigation decline to only 34 percent of the basin's total water requirements by 2040. Municipal and manufacturing water demands are projected to increase significantly over the planning period, nearly doubling from current usage levels. With implementation of municipal water conservation programs and practices, annual savings of municipal water are projected to reach 28,413 acre-feet by 2000, increasing further to 95,871 acre-feet by 2040.

Future Water Supplies. Ground water will continue to provide over 30 percent of available supply for the basin. However, certain cities in the western and central portions of the basin will need to find alternate supplies due to increasing quality problems with their present supplies. With the projected water conservation savings, there are adequate ground-water and surface water supplies available. If the Board's projected conservation savings are not attained, the Shaws Bend Reservoir would be needed to provide supplies for the middle and lower basin.

LAVACA RIVER BASIN



Projected Use of Major and Selected Minor Aquifers
(acre-feet/year)

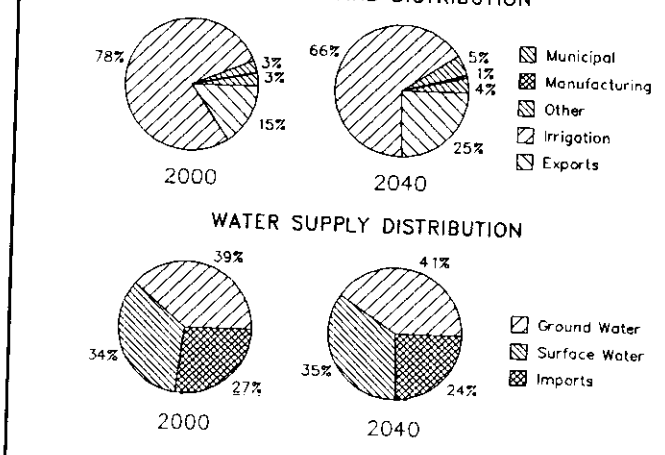
Aquifer	2000 Use	2040 Use
Gulf Coast	98,905	102,194

Projected Supply and Use of Major Water Supply Reservoirs
(acre-feet/year)

Reservoir	2000 Supply	2000 Use	2040 Supply	2040 Use
Texana	75,000	40,404	75,000	70,632

PROJECTED WATER DEMANDS AND SUPPLIES
(acre-feet/year)

ITEM	2000	2040
IN-BASIN DEMAND		
Municipal	8,400	10,348
Manufacturing	733	1,688
Steam Electric	0	6,000
Mining	2,896	3,831
Irrigation	205,155	184,303
Livestock	4,541	4,541
Total In-Basin Demands	221,725	210,771
IN-BASIN SUPPLIES		
Ground Water	99,081	102,468
Surface Water	87,597	88,597
Total In-Basin Supplies	186,678	191,065
TRANSFERS		
Import Supplies	69,404	61,630
Export Demands	40,054	68,530
ADDITIONAL NEW SUPPLIES	0	0
AGRICULTURAL SHORTAGE	(40,293)	(30,914)
NET AVAILABILITY	34,596	4,308



Basin Description. The Lavaca River Basin is bounded on the north and east by the Colorado River Basin, on the west by the Guadalupe River Basin, on the southeast by the Colorado-Lavaca Coastal Basin, and on the southwest by the Lavaca-Guadalupe Coastal Basin (see Figure 1-4). The economy of the basin is based on agriculture, agribusiness, retail and wholesale trade, and manufacturing. In 1980, the basin population totaled about 43,900 people. The current population of the basin is estimated at about 43,800 residents. By the year 2040, population of the Lavaca River Basin is projected to range between 39,400 and 65,900 residents. Major population centers of the basin include the Cities of Yoakum, Edna, Hallettsville, Schulenburg, Shiner, Weimar, Ganado, and Moulton.

Current Water Uses. Total annual water use within the basin is currently 241,700 acre-feet. The largest water demand in the basin is for irrigation with a current use of 229,530 acre-feet. Other major water demands in the basin include municipal and livestock water uses.

Current Water Supplies. The basin's present water needs are met by ground water from the Gulf Coast Aquifer and imports of surface water from the Colorado Basin. The only reservoir in the basin is Lake Texana, operated by the Lavaca-Navidad River Authority (LNRA). The project can supply almost 75,000 acre-feet per year of water for municipal and industrial needs in the basin and adjoining coastal basins. Most cities in the basin use ground water from the Gulf Coast Aquifer.

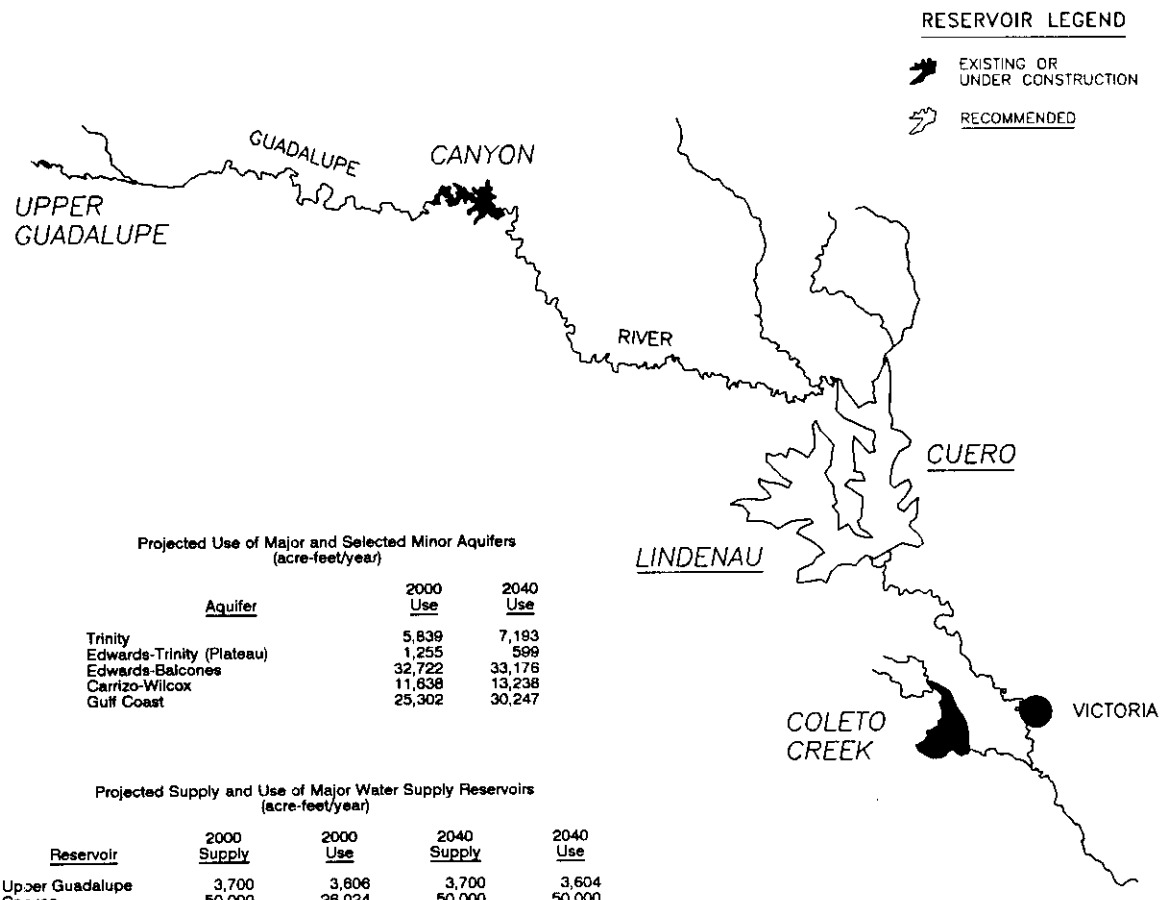
Water supply problems in the basin are overdrafting of the aquifer and related subsidence problems and concerns for reservoir releases for bay and estuary and instream flow needs.

Current Water Quality. Generally, surface water quality is excellent, although the river above tidal influences experiences frequent elevated fecal coliform levels with the main source being runoff from non-confined livestock operations. Ground-water quality from the Carrizo-Wilcox Aquifer is poor, ranging from about 2,000 to 10,000 mg/l TDS, while the Gulf Coast Aquifer supplies are fresh to slightly saline, although higher salinity concentrations exist in downdip portions of the aquifer and near Lavaca Bay.

Future Water Uses. The current water use pattern of the Lavaca River Basin is not expected to change significantly over the planning period, as water requirements for irrigated agriculture are projected to remain the largest water demand category, accounting for over 73 percent of the basin's total water requirements. However, water requirements for irrigation purposes are projected to decline over the planning period due to a moderate reduction in irrigated acreage and anticipated improvements in irrigation practices and implementation of more water use efficient irrigation equipment. With implementation of municipal water conservation programs and practices, annual savings of municipal water is projected to reach 681 acre-feet by the year 2000, and increasing further to 1,822 acre-feet by the year 2040.

Future Water Supplies. Portions of Lake Texana are anticipated to be used to meet industrial growth needs in the adjoining Colorado-Lavaca Basin. Because of significant questions over the dependable yields of the City of Corpus Christi's surface water reservoirs and mandated environmental releases from those projects, the Board is recommending construction of a major conveyance system to also provide supplies from Lake Texana to the Corpus Christi area to meet its needs, even if projected water conservation savings are obtained. If these savings cannot be obtained, Palmetto Bend II Reservoir and potentially other supplies would be needed to meet Corpus Christi area demands. However, regional studies are also evaluating the use of Lake Texana and the Palmetto Bend II site to meet other various needs outside of the basin. The Board, in conjunction with the Texas Parks and Wildlife Department, have studied the potential releases from Lake Texana needed for environmental purposes, although no regulatory decision has yet been made.

GUADALUPE RIVER BASIN



Projected Use of Major and Selected Minor Aquifers
(acre-feet/year)

Aquifer	2000 Use	2040 Use
Trinity	5,839	7,193
Edwards-Trinity (Plateau)	1,255	599
Edwards-Balcones	32,722	33,176
Carrizo-Wilcox	11,638	13,238
Gulf Coast	25,302	30,247

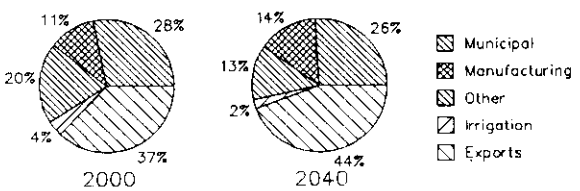
Projected Supply and Use of Major Water Supply Reservoirs
(acre-feet/year)

Reservoir	2000 Supply	2000 Use	2040 Supply	2040 Use
Upper Guadalupe	3,700	3,606	3,700	3,604
Canyon	50,000	28,024	50,000	50,000
Lindenau	101,600	84,284	0	0
Lindenau & Cuero	0	0	208,000	208,000
Coleto Creek	12,500	12,500	12,500	12,500

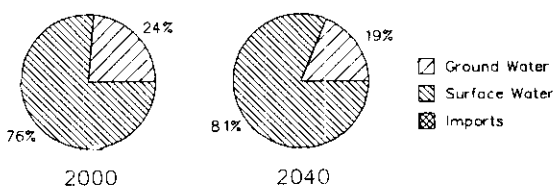
PROJECTED WATER DEMANDS AND SUPPLIES
(acre-feet/year)

ITEM	2000	2040
IN-BASIN DEMAND		
Municipal	80,441	125,668
Manufacturing	32,203	69,296
Steam Electric	42,000	49,000
Mining	2,096	3,166
Irrigation	10,860	10,696
Livestock	12,131	12,131
Total In-Basin Demands	179,731	269,957
IN-BASIN SUPPLIES		
Ground Water	80,576	90,963
Surface Water	159,147	160,748
Total In-Basin Supplies	239,723	251,711
TRANSFERS		
Import Supplies	0	0
Export Demands	106,629	216,010
ADDITIONAL NEW SUPPLIES	101,600	234,146
AGRICULTURAL SHORTAGE	(149)	(206)
NET AVAILABILITY	60,141	96

WATER DEMAND DISTRIBUTION



WATER SUPPLY DISTRIBUTION



Basin Description. The Guadalupe River Basin is bounded on the north by the Colorado River Basin, on the east by the Lavaca River Basin and Lavaca-Guadalupe Coastal Basin, and on the west and south by the San Antonio and Nueces river basins (see Figure 1-4). The economy of the basin is based on mineral production, agriculture, agribusiness, retail and wholesale trade, and manufacturing. In 1980, the basin population totaled about 243,300 people. The current population of the basin is estimated at 303,200 residents, representing an increase of about 25 percent from the 1980 population. By the year 2040, population of the Guadalupe River Basin is projected to range between 564,100 and 692,800 residents. Major population centers of the basin include the Cities of Victoria, San Marcos, New Braunfels, Seguin, Kerrville, Lockhart, Gonzales, Cuero, Luling, and Kyle.

Current Water Uses. Total annual water use in the basin is currently 114,321 acre-feet. Water for municipal use is the largest water demand in the basin with a current use of 54,301 acre-feet. Other water demands placed on the basin's water supplies are exports for use in other basins and manufacturing use.

Current Water Supplies. In the upper part of the basin, the Trinity, Edwards-Trinity, and Edwards-Balcones aquifers are major sources of ground-water supplies. The lower portion of the basin is supplied by ground water from the Carrizo-Wilcox, Queen City, Sparta, and Gulf Coast aquifers.

Canyon Lake Reservoir provides over 50,000 acre-feet per year of surface water supply for use by the Guadalupe-Blanco River Authority (GBRA). There are also six hydroelectric reservoirs on the Guadalupe River below New Braunfels. The GBRA operates Coleto Creek Reservoir for cooling purposes. The GBRA also operates a salt water barrier during low flows to prevent salt water intrusion at the Calhoun Canal system. This canal provides water to the industrial complex on the Victoria Barge Canal.

Other water supply issues in the basin include flooding, conflicts of use, concerns for bay and estuary needs, protection of the springs and the environment around the springs, over-pumpage of ground water, and oil field pollution.

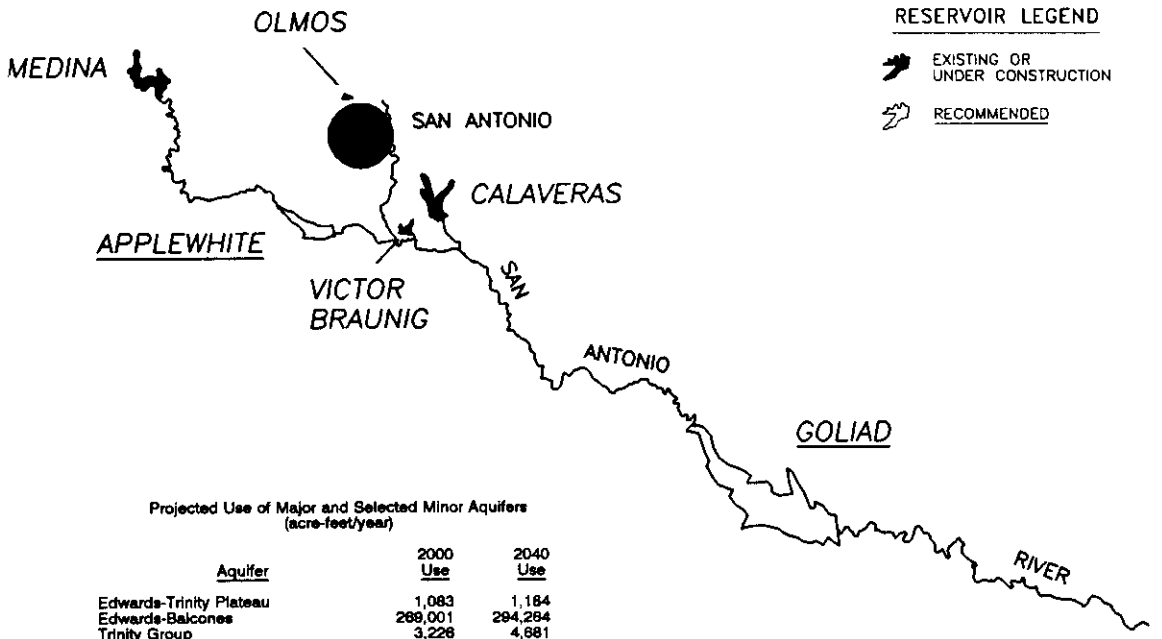
Current Water Quality. Surface water is generally characterized by high quality throughout the basin. Ground-water quality in the basin ranges from fresh (Edwards-Trinity, Trinity, Edwards-Balcones aquifers with TDS levels generally less than 500 mg/l) to fair (Carrizo-Wilcox and Gulf Coast aquifers with TDS generally below 1,000 mg/l). Excessive declines in water levels, potential cessation of springflow, saline water encroachment, and subsidence are problems in use of some of the aquifers in the basin.

Future Water Uses. The current water use pattern of the Guadalupe River Basin is not anticipated to change significantly over the planning period, as water requirements for exports out of the basin are expected to remain the largest water demand on the basin's water supplies. With implementation of municipal water conservation programs and practices, annual savings of municipal water is projected to reach about 6,413 acre-feet by the year 2000, and increasing further to more than 21,929 acre-feet by the year 2040.

Future Water Supplies. In order to insure that the springs at San Marcos and New Braunfels continue to flow, alternative supplies must be developed to supply the San Antonio area. Two reservoirs, Lindenau and Cuero, should be developed in the basin to meet these additional needs. The reservoirs can provide over 208,000 acre-feet per year of dependable supply. Some of the developed supplies can be used to meet needs in the lower part of the basin and the coastal basin presently supplied by Canyon Lake, thus freeing supplies in Canyon to be used in the New Braunfels and San Marcos area.

The Upper Guadalupe River Authority will need to expand the use of in-ground storage to meet the needs in the Authority's service area. It should be noted that while the Cuero site is a recommended surface water supply project because of its proximity to the San Antonio urban area, its large yield, and its relatively low unit cost, it will possibly have major archaeological and environmental problems that would have to be resolved in the permitting process. If they cannot be resolved, then additional supplies in other basins (perhaps as many as two to four replacement reservoirs) would need to be developed to insure the integrity of area spring flows and meet San Antonio area water demands.

SAN ANTONIO RIVER BASIN



Projected Use of Major and Selected Minor Aquifers
(acre-feet/year)

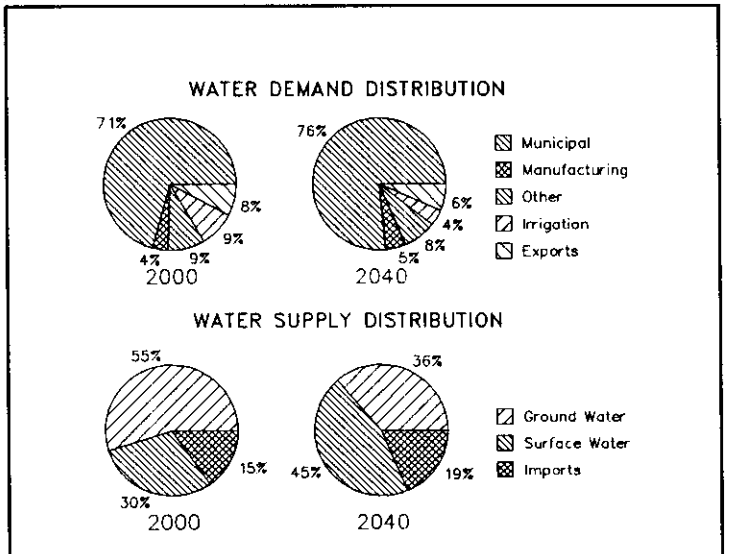
Aquifer	2000 Use	2040 Use
Edwards-Trinity Plateau	1,083	1,164
Edwards-Balcones	269,001	294,264
Trinity Group	3,226	4,681
Carrizo-Wilcox	21,493	26,371
Gulf Coast	5,795	8,133

Projected Supply and Use of Major Water Supply Reservoirs
(acre-feet/year)

Reservoir	2000 Supply	2000 Use	2040 Supply	2040 Use
Medina	39,200	18,099	39,200	31,001
Applewhite	7,900	7,900	7,900	7,900
Goliad	0	0	148,400	148,400

PROJECTED WATER DEMANDS AND SUPPLIES
(acre-feet/year)

ITEM	2000	2040
IN-BASIN DEMAND		
Municipal	359,754	688,959
Manufacturing	19,295	43,993
Steam Electric	36,000	59,000
Mining	3,162	7,972
Irrigation	44,493	35,922
Livestock	6,554	6,554
Total In-Basin Demands	469,258	842,400
IN-BASIN SUPPLIES		
Ground Water	302,165	334,716
Surface Water	127,829	129,468
Total In-Basin Supplies	429,994	464,184
TRANSFERS		
Import Supplies	84,284	172,330
Export Demands	39,470	58,544
ADDITIONAL NEW SUPPLIES	36,872	286,155
AGRICULTURAL SHORTAGE	0	0
NET AVAILABILITY	42,422	21,725



Basin Description. The San Antonio River Basin is bounded on the north and east by the Guadalupe River Basin, and on the south and west by the Nueces River Basin and the San Antonio-Nueces Coastal Basin (see Figure 1-4). The economy of the basin is based on agriculture, agribusiness, retail and wholesale trade, services, manufacturing, government, and tourism. In 1980, the basin population totaled about 1.1 million people. The current population of the basin is estimated at 1.3 million residents, representing an increase of about 18 percent from the 1980 population. By the year 2040, population of the San Antonio River Basin is projected to range between 2.6 and 3.4 million residents. Major population centers of the basin include the Cities of San Antonio, Leon Valley, Universal City, Live Oak, Schertz, Converse, Kirby, Alamo Heights, and the military installations of Fort Sam Houston, Brook Army Medical Center, Kelly, Lackland and Randolph Field Air Force Bases.

Current Water Uses. Total annual water use supplied by the basin's water resources is currently 319,088 acre-feet. The largest demand placed on the basin's water supplies is for municipal purposes with a current use of 242,041 acre-feet. Other major water demands in the basin are irrigation, steam-electric power generation, and export for use in other basins.

Current Water Supplies. Currently the San Antonio basin is supplied by pumpage from the Edwards-Balcones, Edwards-Trinity (Plateau), Trinity, Carrizo-Wilcox, Queen City, Sparta, and Gulf Coast aquifers. The Edwards Aquifer provides almost all of the supplies in the San Antonio area. Dependence on the Edwards-Balcones Aquifer in the upper portion of the basin and the effects of this pumpage on the ground-water reservoir levels, dependable supplies, and spring flow in the Guadalupe Basin are considered a major problem and are receiving considerable scrutiny from both local users and local, state, and federal governments. The Trinity Aquifer provides a minor amount of variable quality water to the upper part of the basin. Water level declines are common during dry periods.

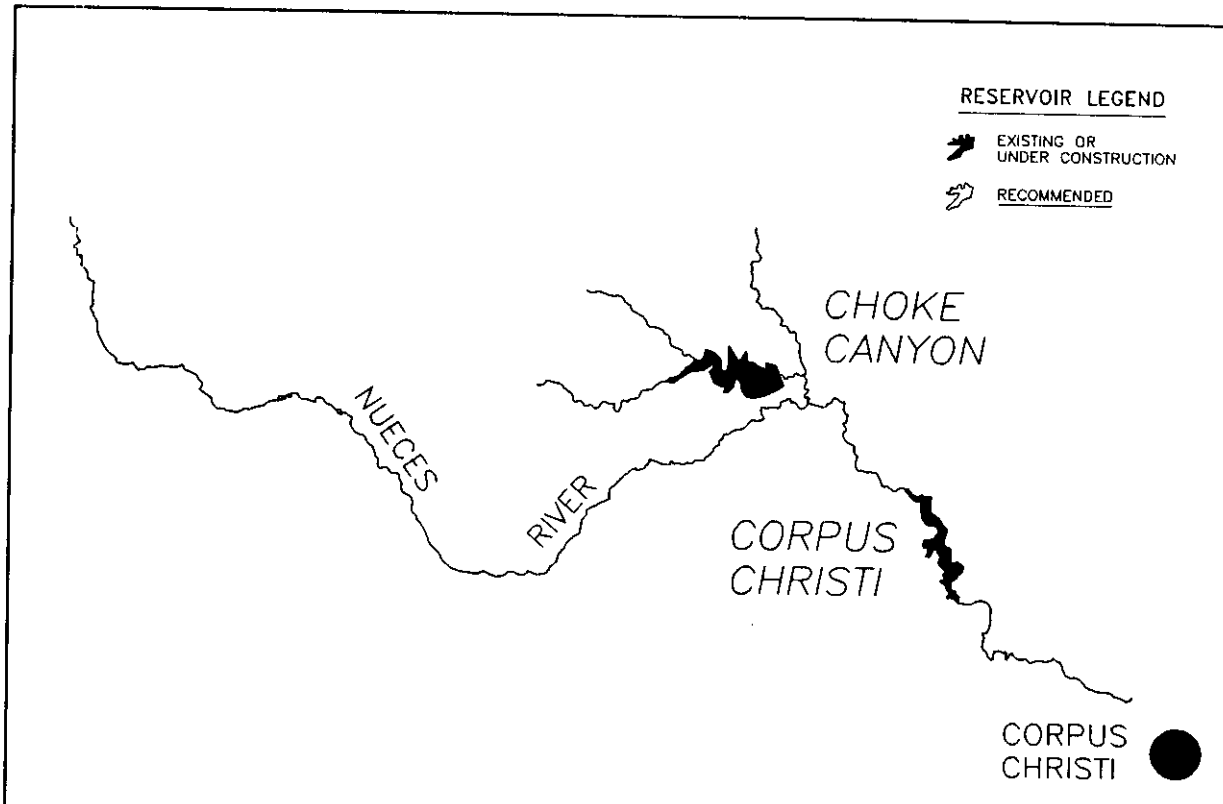
Existing reservoirs in the basin provide water for irrigation (Lake Medina), cooling for steam-electric generation (Braunig and Calaveras Reservoirs), and flood protection (Olmos Reservoir).

Current Water Quality. Improved wastewater treatment facilities have greatly improved surface water quality in the upper reaches of the river. Water quality is stressed or poor in the lower portions of the Leon Creek and the lower Medina River (below the Leon Creek confluence) and mid-Cibolo Creek due to municipal point source discharges. Ground-water quality in the basin ranges from fresh (Edwards-Trinity, Trinity, Edwards-Balcones aquifers with TDS levels generally less than 500 mg/l) to fair (Carrizo-Wilcox and Gulf Coast aquifers with TDS generally below 1,000 mg/l). Excessive declines in water levels, potential cessation of springflow, saline water encroachment, and subsidence are problems in use of some of the aquifers in the basin.

Future Water Uses. The current water use pattern of the San Antonio River Basin is not anticipated to change significantly over the planning period, as water requirements for municipal purposes are projected to account for about 77 percent of the basin's total water requirements by the year 2040. Water requirements for municipal purposes are projected to more than double from current municipal use by the year 2040. With implementation of municipal water conservation programs and practices, annual savings of municipal water are projected to reach about 29,130 acre-feet by the year 2000, and increasing to about 121,496 acre-feet by the year 2040.

Future Water Supplies. If the spring flows in the Guadalupe Basin are to be protected, additional surface water supplies in the San Antonio and Guadalupe River basins will need to be developed for use in the San Antonio area, even with the Board's projected water conservation savings. In the San Antonio Basin, the Goliad and Applewhite reservoirs are recommended for development. These projects will provide over 156,000 acre-feet per year of supplies. Medina Reservoir is also recommended to be converted from only an irrigation supply source to a municipal and irrigation supply source. Among the recommendations for the development of four new surface water reservoirs is the proposed Applewhite Reservoir, scheduled for near-term construction. With the City's proposed operations plan, this project would provide at least 7,900 acre-feet per year during a replication of the historical critical drought. The project could supply about 14,900 acre-feet per year operated on a firm yield basis, and about 45,700 acre-feet per year on a long-term average availability basis. In addition to new reservoirs, the San Antonio area will also need to develop and implement an aggressive reuse program. For the Board's with-conservation forecasts, over 97,000 acre-feet of reuse per year would be needed to meet San Antonio urban area demands. If the projected savings are not attained, Cibolo Reservoir and about 167,000 acre-feet of reuse would be needed to meet the higher area water demands and protect Edwards Aquifer spring flows.

NUECES RIVER BASIN



Projected Supply and Use of Major Water Supply Reservoirs (acre-feet/year)

Reservoir	2000 Supply	2000 Use	2040 Supply	2040 Use
Choke Canyon/ Corpus Christi	178,670	162,736	230,549	230,549

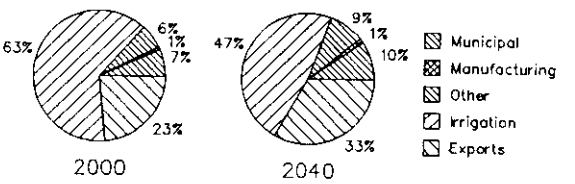
Projected Use of Major and Selected Minor Aquifers (acre-feet/year)

Aquifer	2000 Use	2040 Use
Edwards-Trinity (Plateau)	1,471	2,645
Edwards-Balcones	115,189	120,352
Trinity	235	296
Sparta	4,890	5,838
Queen City	1,985	1,583
Carrizo-Wilcox	125,418	74,234
Gulf Coast	8,958	10,473

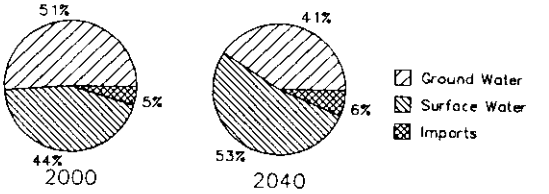
PROJECTED WATER DEMANDS AND SUPPLIES (acre-feet/year)

ITEM	2000	2040
IN-BASIN DEMAND		
Municipal	44,434	63,269
Manufacturing	3,984	7,211
Steam Electric	17,000	32,000
Mining	4,486	7,492
Irrigation	413,357	311,977
Livestock	17,982	17,982
Total In-Basin Demands	501,243	439,931
IN-BASIN SUPPLIES		
Ground Water	258,503	215,739
Surface Water	222,405	277,934
Total In-Basin Supplies	480,908	493,673
TRANSFERS		
Import Supplies	23,265	33,544
Export Demands	153,876	218,021
ADDITIONAL NEW SUPPLIES	0	0
AGRICULTURAL SHORTAGE	(166,880)	(130,735)
NET AVAILABILITY	15,934	0

WATER DEMAND DISTRIBUTION



WATER SUPPLY DISTRIBUTION



Basin Description. The Nueces River Basin is bounded on the north and east by the Colorado, Guadalupe, and San Antonio river basins and the San Antonio-Nueces Coastal Basin, and on the west and south by the Rio Grande Basin and the Nueces-Rio Grande Coastal Basin (see Figure 1-4). The economy of the basin is based on agriculture, agribusiness, trades, and mineral production. The 1980 basin population totaled about 153,500 people (which excludes the majority of Corpus Christi population in the adjacent coastal basin). The current basin population is estimated at 166,800 residents, an increase of about nine percent from the 1980 population. By 2040, basin population is projected to range between 279,600 and 308,900 residents. Major population centers of the basin include a minor portion of the City of Corpus Christi, the cities of Uvalde, Crystal City, Pearsall, Pleasanton, Carrizo Springs, Hondo, Mathis, Devine, and Cotulla.

Current Water Uses. Total annual basin water use is currently 439,500 acre-feet. Water for irrigation is the largest water demand in the basin with a current use of 385,056 acre-feet. Other major demands placed on the basin's water supplies are exports for use in other basins and municipal water use.

Current Water Supplies. The Edwards-Balcones, Edwards-Trinity (Plateau), Trinity, Carrizo-Wilcox, Queen City and Sparta aquifers provide basin ground-water supplies with the Carrizo-Wilcox providing about 60 percent. Overdrafting of the Carrizo-Wilcox is becoming an increasing concern. High pumpage levels in the Edwards-Balcones Aquifer, resultant water-level decline, and related effects on spring and riverine flows are major concerns in the Nueces, San Antonio, and Guadalupe River Basins. The Edwards-Trinity (Plateau) and Trinity aquifers provide a minor amount of variable quality water to the upper part of the basin. Water level declines are common in these aquifers during dry periods.

Lakes Corpus Christi and Choke Canyon are the largest surface water reservoirs in the basin and are capable of producing almost 252,000 acre-feet per year of water supply. However, preliminary studies indicate environmental releases could reduce the supply to 231,000 acre-feet per year. Currently, studies are underway to determine the effective yield of the projects. Most of the supplies in these two projects will be used outside of the basin in the Corpus Christi metropolitan area.

Other water supply problems in the basin are over-pumpage of both the Edwards and Carrizo-Wilcox aquifers resulting in lower water levels as well as saline encroachment. In addition, there is concern about the dependability of Lakes Corpus Christi and Choke Canyon reservoir yields, as well as bay and estuary and instream flow needs.

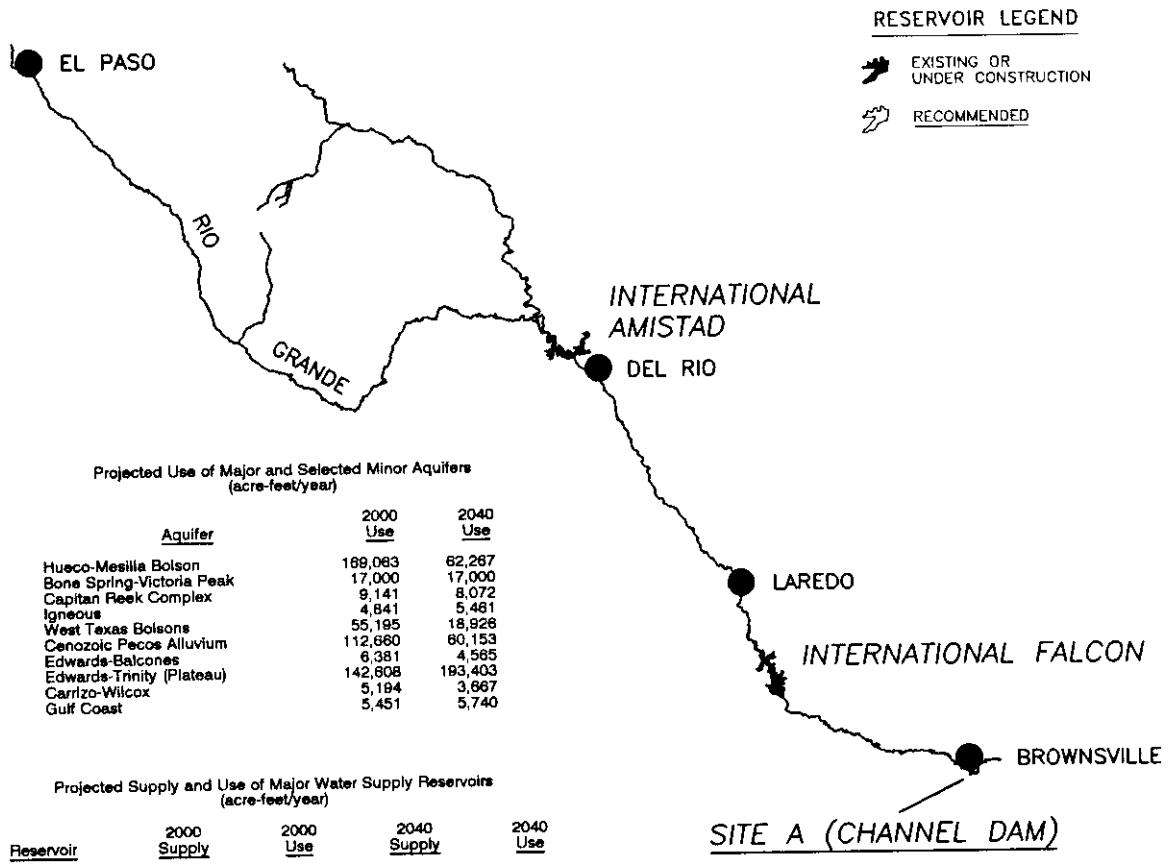
Current Water Quality. Surface water quality in the uninhabited reaches of the river is excellent. Streamflows below the Edwards recharge zone is almost entirely stormwater runoff. During low flow conditions, chloride, sulfate, and total dissolved solids levels increase due to natural conditions and human activities. Water quality of the basin aquifers range from fresh to moderately saline in localized areas. Ground-water quality varies from the higher quality supplies (less than 500 mg/l TDS) of the Edwards-Trinity and Edwards-Balcones aquifers to lesser quality supplies (500 to over 3,000 mg/l TDS) of the Trinity Group, Carrizo-Wilcox, and Gulf Coast aquifers.

Future Water Uses. The current water use pattern of the Nueces River Basin is not anticipated to change significantly over the 50-year planning period,as water requirements for irrigation purposes are projected to remain the major water demand category. However, water demands for irrigated agriculture are projected to decrease over the 50-year period due to a small decline in irrigated acreage and anticipated improvements in irrigation practices and equipment. Likewise, annual savings of municipal water through water conservation are projected to reach 3,428 acre-feet by 2000, and 10,778 acre-feet by 2040.

Future Water Supplies. In the future, ground-water usage in the Carrizo-Wilcox Aquifer will decline due to overdrafting of the aquifer in the Winter Garden area and in the Edwards-Balcones Aquifer in Medina and Uvalde counties.

Lakes Corpus Christi and Choke Canyon will continue to supply water to the San Antonio-Nueces and the Nueces-Rio Grande basins, including the City of Corpus Christi and suburban areas. Concerns over the effective yields of these projects and impacts of environmental releases will require Corpus Christi to obtain additional supplies in the future even with the Board's projected water conservation savings. The Board is recommending construction of a pipeline to secure future supplies from Lake Texana. If conservation savings are not obtained, additional supplies would also be needed from Palmetto Bend II Reservoir or even potentially other sources, given the ultimate result of the Nueces Basin yield studies.

RIO GRANDE BASIN



Projected Use of Major and Selected Minor Aquifers
(acre-feet/year)

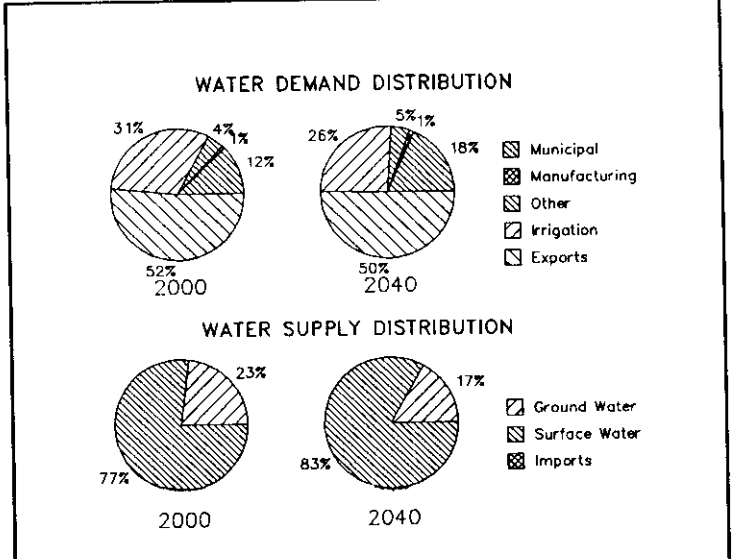
Aquifer	2000 Use	2040 Use
Hueco-Mesilla Bolson	169,063	62,267
Bone Spring-Victoria Peak	17,000	17,000
Capitan Reek Complex	9,141	8,072
Igneous	4,841	5,481
West Texas Bolsons	55,195	18,926
Cenozoic Pecos Alluvium	112,660	80,153
Edwards-Balcones	6,381	4,565
Edwards-Trinity (Plateau)	142,608	193,403
Carrizo-Wilcox	5,194	3,667
Gulf Coast	5,451	5,740

Projected Supply and Use of Major Water Supply Reservoirs
(acre-feet/year)

Reservoir	2000 Supply	2000 Use	2040 Supply	2040 Use
Falcon-Amistad	1,500,000	1,418,060	1,500,000	1,500,000
Rio Grande Project	128,700	128,700	128,700	128,700
Site A Channel Dam	0	0	85,000	84,081

PROJECTED WATER DEMANDS AND SUPPLIES
(acre-feet/year)

ITEM	2000	2040
IN-BASIN DEMAND		
Municipal	277,516	474,030
Manufacturing	15,800	25,607
Steam Electric	16,000	21,000
Mining	54,346	75,343
Irrigation	710,815	673,060
Livestock	21,804	21,804
Total In-Basin Demands	1,096,281	1,290,844
IN-BASIN SUPPLIES		
Ground Water	532,700	388,910
Surface Water	1,725,352	1,750,557
Total In-Basin Supplies	2,258,052	2,139,467
TRANSFERS		
Import Supplies	0	0
Export Demands	1,168,488	1,298,767
ADDITIONAL NEW SUPPLIES	61,100	175,000
AGRICULTURAL SHORTAGE	(27,557)	(171,447)
NET AVAILABILITY	81,940	(103,697)



Basin Description. The Rio Grande Basin is bounded on the north by New Mexico and on the south by Mexico and stretches southerly toward the Gulf of Mexico (Figure 1-4). The basin economy is based on agriculture, agribusiness, manufacturing, mineral production, trades, government, and tourism. The 1980 basin population totaled about 781,000 people. The current basin population is estimated at 929,900, up about 19 percent since 1980. By 2040, the basin population is projected to range between 2.0 and 2.4 million residents. Major population centers include the Cities of El Paso, Laredo, Del Rio, Eagle Pass, Pecos, Rio Grande City, Fort Stockton, Monahans, Kermit, Alpine, and the Fort Bliss military installation.

Current Water Uses. Total annual basin water use is currently 770,997 acre-feet. The largest demand placed on the basin's supplies is for export to other basins, currently estimated at 1.1 million acre-feet. Much of these exports are delivered for irrigation use in the adjoining Nueces-Rio Grande Coastal Basin. Water for irrigation is the largest basin water demand with a current use of 538,133 acre-feet. Municipal use in the basin is currently 196,090 acre-feet.

Current Water Supplies. In the northern basin, ground water is the major supply source. The City of El Paso is primarily supplied from the Hueco-Mesilla Bolson Aquifer and, to a lesser extent, with Rio Grande surface water. Other important aquifers include the Bone Spring-Victorio Peak, Cenozoic Pecos Alluvium, Edwards-Trinity (Plateau), and West Texas Bolsons. In the El Paso area, supplies (primarily for agriculture) are provided by the Rio Grande Project of New Mexico-Texas with water from Elephant Butte Reservoir in New Mexico. Problems with sedimentation, flooding, and water quality below the dam in New Mexico are or may be affecting river conditions and supplies delivered to Texas. Below Lake Amistad, most water used is from Lakes Amistad and Falcon and the Rio Grande. The 57,292 acre Amistad Recreation Area is a unit of the National Park Service, managed for national park purposes under a cooperative agreement with the International Boundary and Water Commission. Ground-water sources in the middle/lower basin include the Carrizo-Wilcox and Gulf Coast aquifers. Growth along the border in Mexico and New Mexico also places water demands and water quality treatment needs on the rivers and aquifers, thus affecting available water supplies in the basin in Texas, although these are not fully considered in the Board's analysis.

Current Water Quality. Riverine water quality varies significantly in the basin. Effluent and irrigation return flows dominate river volumes below El Paso. Saline inflows increase riverine dissolved solids levels between the confluence of the Pecos River and Lake Amistad. Both of these influences become less severe with more dilution from intervening inflows to the river. Below Amistad, saline irrigation return flows, suspected contaminated agricultural runoff, and municipal and industrial wastewater discharges are or may be impairing downstream water quality. Ground-water quality ranges from fresh to moderately saline in the major aquifers with threat of increased salinity encroachment from declines in ground-water levels.

Future Water Uses. The current basin water use pattern should not change significantly in the next 50 years, as exports are projected to remain the major water use for the basin's water supply. However, water needs for municipal purposes are projected to more than double by 2040. Annual municipal water savings through conservation practices should reach 22,274 acre-feet by 2000, and 83,162 acre-feet by 2040.

Future Water Supplies. In El Paso County, the Board projects additional water reuse will increase available supplies by about 40,000 acre-feet per year. However, without further additional supplies, the El Paso County area will have an overall deficit of over 176,000 acre-feet annually by 2040. The Board's forecast indicates a water deficit of about 70,000 acre-feet per year for the City of El Paso by 2040. A water management plan near completion, being conducted for the city service area by the El Paso Public Service Board and El Paso County Water Improvement District No. 1, indicates slightly higher conservation savings and slightly lower or no water supply deficit results by 2040 (given the degree of ground-water availability from nearby Bolson deposits) when compared to the Board's forecast.

In the lower basin, a new channel dam (Site A) on the river below Brownsville, which would provide for local supplies, is recommended. Various studies indicate that total annual project supplies could range from 15,000 to 200,000 acre-feet. The Board estimates the project's U.S. supply availability at about 85,000 acre-feet annually based on gaged flows in the river near Brownsville. The ultimate availability will be determined during the State permitting process and considering negotiations with Mexico. Concerns about aquatic and terrestrial habitat, water quality, "no charge" pumping, flooding, and off-channel storage options should also be given full consideration in the permitting process.

Even with the Board's projected conservation savings, additional reuse, and the provision of a new reservoir, a supply deficit of about 100,000 acre-feet per year is projected for the basin by 2040.

The projected water demands and supplies of the eight Texas coastal basins are shown in Table 3-4 for the years 2000 and 2040. As previously discussed, the assumption of "safe yield" pumping of the local aquifers has lessened the projected available ground-water supply and results in the agricultural water shortages indicated for many of the coastal basins.

NECHES-TRINITY COASTAL BASIN

Basin Description. The Neches-Trinity Coastal Basin is bounded on the north by the Neches and Trinity river basins, on the east by Sabine Lake, and on the west by Galveston and Trinity Bays (see Figure 1-4). The economy of the area is based on manufacturing, oil production, agriculture, agribusiness, commercial shipping and fishing, and trades. The 1980 basin population totaled 203,700 people. Currently, the basin population is about 198,700 residents, a decline of about 2.5 percent since 1980. By 2040, the basin population should range between 254,300 and 291,000 residents. Major basin population centers include all or portions of the cities of Beaumont, Port Arthur, Nederland, and Groves.

Current Water Uses. Total annual water use in the basin is currently 361,742 acre-feet. By far, the largest water demand in the basin is for irrigation purposes with a current use of 262,768 acre-feet.

Current Water Supplies. There are no major water-supply reservoirs in the basin. The J.D. Murphree impoundments, owned by the Texas Parks and Wildlife Department, are used for wildlife management purposes. Surface water is supplied to the basin primarily from the Trinity and Neches River Basins. The Gulf Coast Aquifer supplies over 13,000 acre-feet per year of ground water to the basin.

Future Water Uses. The regional water use pattern is not anticipated to change significantly over the 50-year planning period as water requirements for irrigated agriculture are projected to remain the largest water use within the basin. Although irrigation is expected to remain the major water demand category, water use for irrigation is projected to decline slightly over time due to improvements and more efficient water use management practices and equipment. Additionally, annual municipal water savings, through implementation of municipal water use conservation programs and practices, are projected to reach 2,591 acre-feet by the year 2000 and nearly 7,427 acre-feet by the year 2040.

Future Water Supplies. Any additional needs for surface water will be met from supplies in the Neches and Trinity river basins. There are adequate supplies available in these basins to meet the future needs of the Neches-Trinity Coastal Basin.

TRINITY-SAN JACINTO COASTAL BASIN

Basin Description. The Trinity-San Jacinto Coastal Basin is bounded on the east by the Trinity River Basin and the Neches-Trinity Coastal Basin, on the west and north by the San Jacinto River Basin and the San Jacinto-Brazos Coastal Basin, and on the south by Trinity and Galveston Bays (see Figure 1-4). The economy of the area is based on manufacturing, agriculture, trades, services, commercial fishing, and tourism. The 1980 basin population totaled 80,200 people. The current basin population is estimated at 92,500, up about 15 percent since 1980. By 2040, the basin population is projected to range between 145,900 and 169,900 residents. Baytown is the largest city in the basin with a population of over 60,000 people. Other basin cities include all or portions of the cities of Highlands, Barrett, McNair, Crosby, and Mont Belvieu.

Current Water Uses. Total annual water use in the basin is currently 119,667 acre-feet. Manufacturing is the largest water using category with a current use of 66,856 acre-feet, followed by municipal water use at 20,093 acre-feet.

TABLE 3-4
PROJECTED WATER DEMANDS AND SUPPLIES OF
TEXAS COASTAL BASINS, 2000 AND 2040
(acre-feet per year)

Item	Neches-Trinity 2000	Neches-Trinity 2040	Trinity-San Jacinto 2000	Trinity-San Jacinto 2040	San Jacinto-Brazos 2000	San Jacinto-Brazos 2040	Brazos-Colorado 2000	Brazos-Colorado 2040
IN-BASIN DEMAND								
Municipal	32,337	42,445	18,297	24,280	139,061	205,363	17,721	26,311
Manufacturing	73,863	93,616	73,228	97,137	200,058	418,882	23,595	58,320
Steam Electric	0	0	900	2,000	2,200	2,500	0	0
Mining	1,808	1,893	11,104	12,484	1,388	1,412	12,143	14,328
Irrigation	193,734	196,675	37,079	37,152	135,391	125,075	231,728	207,220
Livestock	1,085	1,085	211	211	1,449	1,449	2,399	2,399
Total In-Basin Demand	302,827	335,714	140,819	173,264	479,547	754,681	287,586	308,578
IN-BASIN SUPPLIES								
Ground Water	13,661	12,742	10,116	10,856	57,600	49,655	79,441	82,352
Surface Water	18,667	19,214	6,033	6,033	61,288	61,882	31,747	33,559
Total In-Basin Supply	32,328	31,956	16,149	16,889	118,888	111,537	111,188	115,911
TRANSFERS								
Import Supplies	270,499	303,758	124,670	156,375	324,136	613,138	166,312	186,802
Export Demands	0	0	0	0	0	0	0	0
ADDITIONAL NEW SUPPLIES	0	0	0	0	0	8,867	0	0
AGRICULTURAL SHORTAGE	0	0	0	0	(36,523)	(21,139)	(10,086)	(5,865)
NET AVAILABILITY	0	0	0	0	0	0	0	0

Item	Colorado-Lavaca 2000	Colorado-Lavaca 2040	Lavaca-Guadalupe 2000	Lavaca-Guadalupe 2040	San Antonio-Nueces 2000	San Antonio-Nueces 2040	Nueces-Rio Grande 2000	Nueces-Rio Grande 2040
IN-BASIN DEMAND								
Municipal	5,206	7,653	7,667	11,418	20,273	28,071	279,524	531,778
Manufacturing	41,919	42,213	24,103	52,634	14,332	28,042	44,008	70,843
Steam Electric	200	200	0	0	0	0	6,000	10,500
Mining	348	206	982	1,136	1,202	292	2,929	2,444
Irrigation	125,684	112,622	49,281	44,574	4,837	4,837	995,792	917,960
Livestock	1,197	1,197	1,592	1,592	3,011	3,011	11,455	11,455
Total In-Basin Demand	174,554	164,091	83,625	111,354	43,655	64,253	1,339,708	1,544,980
IN-BASIN SUPPLIES								
Ground Water	57,036	57,685	22,000	24,420	11,670	11,460	40,163	45,407
Surface Water	7,986	7,986	15,835	13,583	1,608	1,608	5,832	5,973
Total In-Basin Supply	65,022	65,671	37,835	38,003	13,278	13,068	45,995	51,380
TRANSFERS								
Import Supplies	89,386	84,815	38,550	68,680	29,014	49,910	1,293,350	1,493,237
Export Demands	0	0	0	0	0	0	0	0
ADDITIONAL NEW SUPPLIES	0	0	0	0	0	0	0	0
AGRICULTURAL SHORTAGE	(20,146)	(13,605)	(7,240)	(4,671)	(1,363)	(1,275)	(363)	(363)
NET AVAILABILITY	0	0	0	0	0	0	0	0

Current Water Supplies. Cedar Bayou Reservoir, which supplies saline water from Cedar Bayou for steam electric power generation, is the only water supply reservoir in the basin. Almost 9,688 acre-feet per year of ground water are currently being supplied by the Gulf Coast Aquifer to basin users. All other basin needs are supplied by surface water from the San Jacinto River Authority with diversions from Lake Houston and from the Trinity River Basin through the Coastal Industrial Water Authority.

Future Water Uses. Manufacturing water use is expected to continue to be the major water using sector in the coastal basin throughout the planning period. Irrigation is also projected to be a major water user; however, the quantity of use is expected to decline slightly due to improvements in both management practices and equipment. Annual savings in municipal water use, realized through conservation practices, are projected to reach 1,481 acre-feet by the year 2000, increasing to 4,284 acre-feet by 2040.

Future Water Supplies. Future needs of the basin will be supplied by additional use of ground water and additional diversions from the Trinity River Basin.

SAN JACINTO-BRAZOS COASTAL BASIN

Basin Description. The San Jacinto-Brazos Coastal Basin is bounded on the north by the San Jacinto River Basin, on the east by Galveston Bay and the Trinity-San Jacinto Coastal Basin, and on the west by the Brazos River Basin (see Figure 1-4). The economy of the coastal basin is based on manufacturing, agriculture, trades, services, commercial shipping and fishing, and tourism. The current population of the basin is estimated at 647,100 people, up from the 1980 population of 536,800. By the year 2040, the basin population is projected to range between 1.1 and 1.3 million residents. Major cities lying wholly or partially within the basin include Houston, Pasadena, Galveston, Texas City, Missouri City, League City, and Deer Park.

Current Water Uses. Total annual water use in the basin is currently 403,301 acre-feet. The largest water using category in the basin is irrigation with a current use of 155,311 acre-feet. Other major water demands are manufacturing and municipal water use with a combined use of 243,617 acre-feet.

Current Water Supplies. There are no major surface water reservoirs with conservation (water supply) storage in the basin. The only major water supply available within the basin is ground water from the Gulf Coast Aquifer with over 55,000 acre-feet per year in current use. All other supplies are imported from the Brazos, Trinity, or the San Jacinto river basins. The Brazos River Authority provides water to the basin from reservoirs in the Brazos River Basin. Other major suppliers of water from the Brazos River Basin are Dow Chemical Company, Chocolate Bayou Company, and Galveston County Water Authority which use river diversions backed-up by water supplies from the Brazos River Authority. The City of Houston provides treated water to a number of cities in the basin that are converting from ground water to surface water in compliance with the Harris-Galveston Coastal Subsidence District mandate. The Coastal Water Authority also provides water supplies to the coastal basin from the Trinity River Basin.

Future Water Uses. Manufacturing and municipal water requirements are both projected to surpass irrigation water requirements in the basin during the projection period. Irrigation water use is expected to decline due to moderate reduction of irrigated acreage and improvements in management practices and equipment. Through water conservation practices, annual municipal water savings are projected to reach 11,234 acre-feet by year 2000, and nearly 36,151 acre-feet by 2040.

Future Water Supplies. Because of anticipated subsidence problems outside of Harris and Galveston Counties, it was assumed that other areas in the basin would approach the subsidence problem in a manner similar to the Harris-Galveston Coastal Subsidence District (HGCSD). Subsidence problem areas were

converted to surface water, phased in over a 20-year period. The conversion was phased in similar to the HGCSD conversion, but 10 years later in time. The conversion to surface water will require the development of additional surface-water supplies in the Brazos River Basin and additional water conveyance facilities from the Trinity and Sabine river basins. By the year 2040, the reuse of wastewater from Houston will provide about 65,000 acre-feet per year of additional supplies to the industrial users in the basin.

BRAZOS-COLORADO COASTAL BASIN

Basin Description. The Brazos-Colorado Coastal Basin is bounded on the east by the Brazos River Basin, on the west by the Colorado River Basin, and on the south by the Gulf of Mexico (see Figure 1-4). The basin economy is based on manufacturing, agriculture, agribusiness, and trades. The 1980 basin population totaled 81,700 people. Current basin population is estimated at 86,800 residents, an increase of nearly six percent from the 1980 population. By 2040, population of the basin is projected to range between 156,000 and 176,500 residents. Major basin population centers include all or portions of the cities of Bay City, Freeport, Wharton, West Columbia, Eagle Lake, Sweeney, Brazoria, Jones Creek, and Needville.

Current Water Uses. Total annual water use in the basin is currently 344,178 acre-feet. The largest water demand in the coastal basin is for irrigation purposes with a current use of 305,591 acre-feet.

Current Water Supplies. Presently the basin is supplied with over 84,000 acre-feet per year from the Gulf Coast Aquifer, imports from the Colorado Basin, and supplies from creeks and rivers in the basin.

Future Water Uses. The current water use pattern of the Brazos-Colorado Coastal Basin is not expected to change significantly over the planning period, as water demands for irrigated agriculture are projected to remain the largest water demand. However, irrigation water demands are projected to decline over the 50-year planning period due to a moderate reduction in irrigated acreage and improvements in irrigation practices and equipment. Likewise, implementation of municipal water conservation programs is projected to reduce municipal water use by more than 1,434 acre-feet by 2000, and 4,638 acre-feet by 2040.

Future Water Supplies. It is anticipated the coastal basin will continue to be supplied from the adjacent Colorado River Basin and that ground-water usage will remain at about its current level.

COLORADO-LAVACA COASTAL BASIN

Basin Description. The Colorado-Lavaca Coastal Basin is bounded on the east by the Colorado River Basin and on the west by the Lavaca-Guadalupe Coastal Basin and the Lavaca River Basin (see Figure 1-4). The economy is based on manufacturing, agriculture, retail and wholesale trades, agribusiness, commercial fishing, and tourism. In 1980, the population totaled 25,600 people, while the current basin population is estimated at about 26,700 residents (an increase of about four percent since 1980). By the year 2040, the basin population is projected to range between 44,600 and 51,400 residents. Major basin population centers include the cities of El Campo, Palacios, and Point Comfort.

Current Water Uses. Total annual water use in the basin is currently 157,097 acre-feet. The largest water demand in the basin is for irrigated agricultural with a current use of 147,188 acre-feet.

Current Water Supplies. Presently the coastal basin is supplied with over 57,000 acre-feet per year from the Gulf Coast Aquifer. Surface water imports are also made from the Colorado and Lavaca river basins. Imports from the Colorado River Basin are mostly used for irrigation purposes, while supplies from the Lavaca Basin meet local industrial needs. Water from the Colorado River is also used to maintain the

cooling capacity of the South Texas project. All cities in the coastal basin are supplied by the Gulf Coast Aquifer. However, the major use of the aquifer is for irrigation. Problems in the basin are overdrafting of the aquifer and bay and estuary needs.

Future Water Uses. The current water use pattern of the Colorado-Lavaca Coastal Basin is not expected to change significantly over the next 50 years, as water requirements for irrigation are projected to remain the largest water use category. However, manufacturing water requirements in the coastal basin are projected to increase significantly over the planning period due to the expansion of the basin's petrochemical industrial base. With implementation of municipal water conservation programs and practices, annual savings of municipal water is projected to reach 415 acre-feet by 2000, increasing to 1,337 acre-feet by 2040.

Future Water Supplies. Ground-water withdrawals should be reduced to the safe yield of the Gulf Coast Aquifer, providing supplies of about 57,700 acre-feet a year by 2040. Surface water imports from the Colorado River Basin will continue to meet irrigation and industrial cooling needs of the basin. Imports from the Lavaca Basin will increase with the expansion of industrial plants and conversion of some cities to surface water.

LAVACA-GUADALUPE COASTAL BASIN

Basin Description. The Lavaca-Guadalupe Coastal Basin is bounded on the east by the Lavaca River Basin and the Colorado-Lavaca Coastal Basin, and on the west by the Guadalupe River Basin and San Antonio-Nueces Coastal Basin (see Figure 1-4). The economy of the coastal basin is based on mineral production, agriculture, agribusiness, retail and wholesale trades, manufacturing, and commercial fishing. Basin population totaled 37,900 people in 1980. The current basin population is estimated at 41,400, an increase of about nine percent since 1980. By 2040, the population of the Lavaca-Guadalupe Coastal Basin is projected to range between 68,400 and 78,600 residents. Major basin population centers lying wholly or partially in the coastal basin include the Cities of Victoria, Port Lavaca, and Bloomington.

Current Water Uses. Total annual water use in the coastal basin is currently 81,159 acre-feet. Irrigation is the largest water demand in the basin with a current use of 56,840 acre-feet, followed by manufacturing with a use of 17,693 acre-feet.

Current Water Supplies. All current coastal basin water needs are met from the Gulf Coast Aquifer or with surface water imports from the Guadalupe Basin by the Guadalupe-Blanco River Authority (GBRA). Port Lavaca and the industrial complex on the Victoria barge canal are also supplied by the GBRA.

Future Water Uses. The current water use pattern of the Lavaca-Guadalupe Coastal Basin should change over the planning period, as municipal and manufacturing water uses are projected to surpass irrigation needs. Irrigation water use is projected to decline over the next 50 years due to a moderate reduction in irrigated acreage and anticipated improvements in irrigation practices and equipment. With implementation of municipal water conservation programs, annual savings of water are projected to reach about 623 acre-feet by 2000, increasing to 2,010 acre-feet by 2040.

Future Water Supplies. The basin will continue to be supplied by the GBRA, however the supplies will be from reservoirs in the lower Guadalupe Basin instead of the Canyon Lake reservoir. Ground water will continue to supply over 20 percent of the needs of the coastal basin.

SAN ANTONIO-NUECES COASTAL BASIN

Basin Description. The San Antonio-Nueces Coastal Basin is bounded on the north and east by the San Antonio River Basin and the Lavaca-Guadalupe Coastal Basin, and on the south and west by the Nueces River Basin and the Nueces-

Rio Grande Coastal Basin (see Figure 1-4). The economy of the basin is based on agriculture, agribusiness, retail and wholesale trades, mineral production, manufacturing, commercial fishing, and tourism. The 1980 basin population totaled 98,700 people. Current basin population is estimated at 108,900 residents, representing an increase of about 10 percent from the 1980 population. By the year 2040, population of the San Antonio-Nueces Coastal Basin is projected to range between 172,000 and 191,000 residents. Major population centers of the basin include the Cities of Beeville, Portland, Aransas Pass, Ingleside, Sinton, Rockport, Refugio, Taft, and Odem.

Current Water Uses. Total annual water use in the coastal basin is currently 24,850 acre-feet. Water for municipal purposes is the largest water demand in the basin with a current level of use of 12,859 acre-feet per year, followed by manufacturing with a water use of 7,240 acre-feet annually.

Current Water Supplies. The coastal basin is supplied by ground water from the Gulf Coast Aquifer and importation of surface water from the Nueces Basin. The San Patricio Municipal Water Authority has contracted for almost 34,700 acre-feet per year of water supplies from the City of Corpus Christi.

Future Water Uses. The current water use pattern of the coastal basin is projected to change significantly over the next 50 years, as water requirements for manufacturing are projected to nearly equal municipal water requirements by the year 2040. Annual savings in municipal water, due to implementation of municipal water conservation programs and practices, are projected to reach 1,594 acre-feet by 2000, increasing further to 4,843 acre-feet by 2040.

Future Water Supplies. The coastal basin will continue to rely on the adjacent Nueces River Basin to provide most of the supplies for the basin. However, additional contractual commitments for future water supplies will need to be secured from Corpus Christi.

NUECES-RIO GRANDE COASTAL BASIN

Basin Description. The Nueces-Rio Grande Coastal Basin is bounded on the north by the Nueces River Basin and on the west and south by the Rio Grande Basin (see Figure 1-4). The economy of the coastal basin is based on agriculture, agribusiness, manufacturing, retail and wholesale trades, mineral production, commercial shipping, commercial fishing, and tourism. The 1980 coastal basin population basin totaled 853,400 people. The current coastal basin population is estimated at about 1.0 million residents, an increase of 21 percent from the 1980 population. By the year 2040, the coastal basin population is projected to range between 2.4 and 2.9 million residents. Major population centers of the basin include the Cities of Corpus Christi, Brownsville, McAllen, Harlingen, Mission, Edinburg, Pharr, Kingsville, Weslaco, and San Benito.

Current Water Uses. Total water use in the Nueces-Rio Grande Coastal Basin is currently 1,195,555 acre-feet. Irrigation water use is the largest water demand in the coastal basin, accounting for 82 percent of the basin's total water use.

Current Water Supplies. The northern part of the coastal basin is supplied by Lakes Corpus Christi and Choke Canyon in the Nueces River Basin. The southern part of the coastal basin is supplied by Lakes Falcon and Amistad in the Rio Grande Basin. Total imports of water into the coastal basin are over 1,100,000 acre-feet per year. The Gulf Coast Aquifer provides over 15,000 acre-feet per year to the basin. Water-related problems in the coastal basin are inadequate wastewater and water facilities in economically distressed areas, flooding, pesticide residue in Arroyo Colorado, and bay and estuary concerns.

Future Water Uses. The current water use pattern of the Nueces-Rio Grande Coastal Basin is not anticipated to change significantly over the planning period, as water requirements for irrigation purposes are projected to remain the major water demand category. Water requirements for irrigated agriculture are

projected to decline only slightly over the planning period due to anticipated improvements in irrigation practices and equipment. Municipal water requirements are projected to more than double the current municipal water use in the basin by the year 2040. Annual savings of municipal water through water conservation practices are projected to reach 22,494 acre-feet by the year 2000, and 93,477 acre-feet by the year 2040.

Future Water Supplies. The coastal basin will continue to rely on the Nueces River and Rio Grande basins to meet most of its needs. Imported water supplies will grow to about 1.5 million acre-feet by 2040. This will require the construction of the "Site A" Channel Dam below Brownsville to provide supplies for Brownsville and Harlingen. The northern part of the coastal basin will also need to develop a water reuse program. The program could provide only limited water supplies due to permit constraints on Lakes Corpus Christi and Choke Canyon. Given the potential limitation on reuse, questions concerning the reliability of firm yield estimates for Corpus Christi's surface water reservoirs, and mandated environmental releases, additional supplies imported from Lake Texana and potentially Palmetto Bend II in the Lavaca River Basin are recommended to help meet the future needs of the northern coastal basin area.

PROJECTED REGIONAL AND LOCAL WATER DEMANDS, SUPPLIES, AND FACILITY NEEDS

While the Texas Water Code places emphasis on the evaluation of river basin water demands and supplies, many of the State's water-related problems, needs, and opportunities for action are more closely related to particular regional and local characteristics. The various regions of this large state each possess their own unique socioeconomic, physiographic, climatological, and hydrologic factors that make their needs somewhat distinctive from other areas of the State.

As discussed in the first portions of Section 2, it is the intent of the Board to expand upon the regional aspects of water planning in subsequent updates of the state Water Plan. This revised approach will require careful delineation of new regional boundries and modification of the Board's data bases and computer software.

In this Plan, the Board has evaluated eight regions of the State and has projected costs of identified water, wastewater, and flood protection facility needs over the 50 year planning period (see Figure 3-15). As also indicated previously in Figures 3-9 through 3-14, the magnitude of these prospective water-related facilities expenditures is highly related to the relative population densities of the various regions.

The following section relates a summary of information on a regional and local basis. Shown in each of the following regional sections are those facilities costs related to the Board's high case growth "with conservation" water demand forecast.

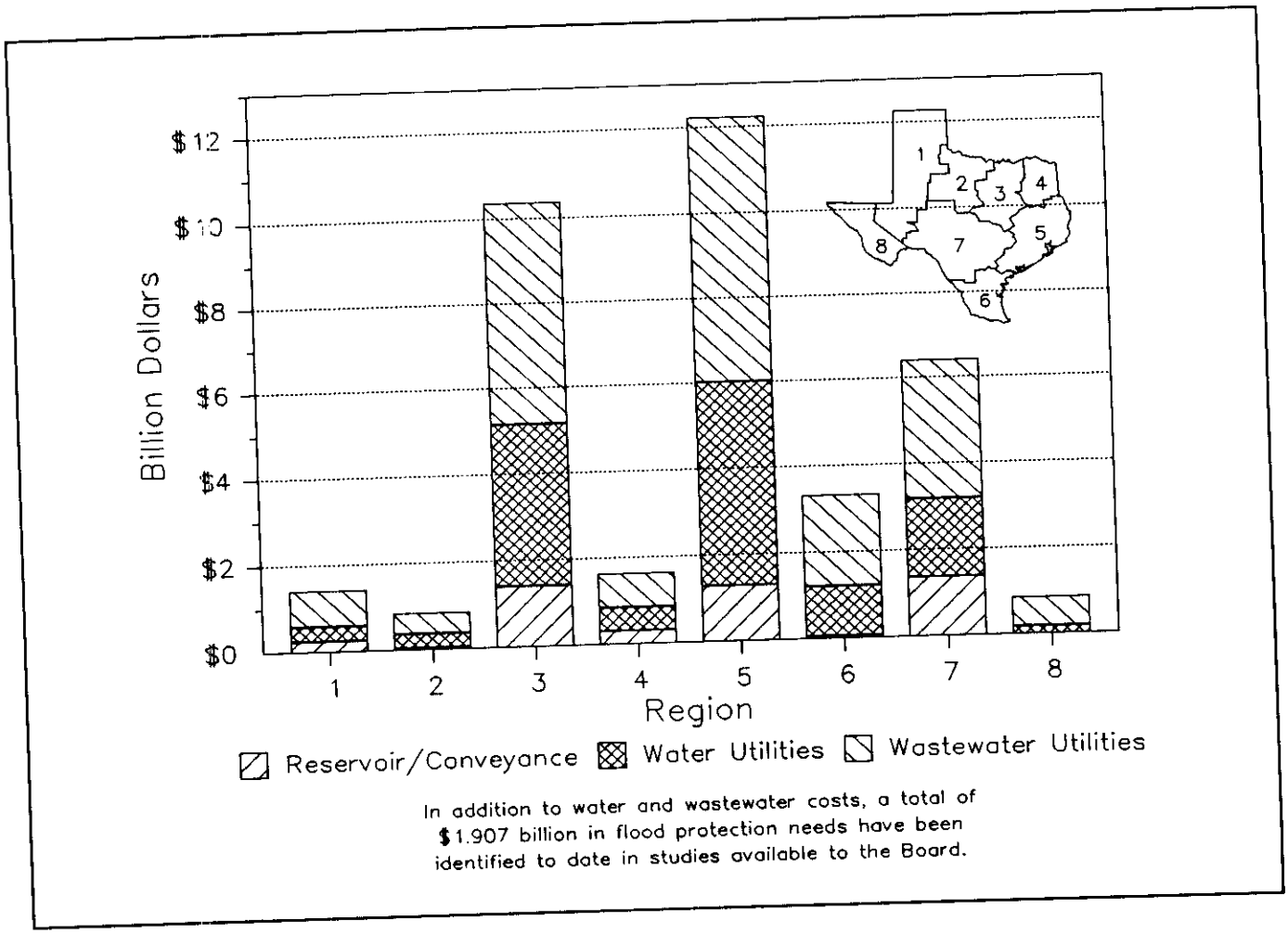
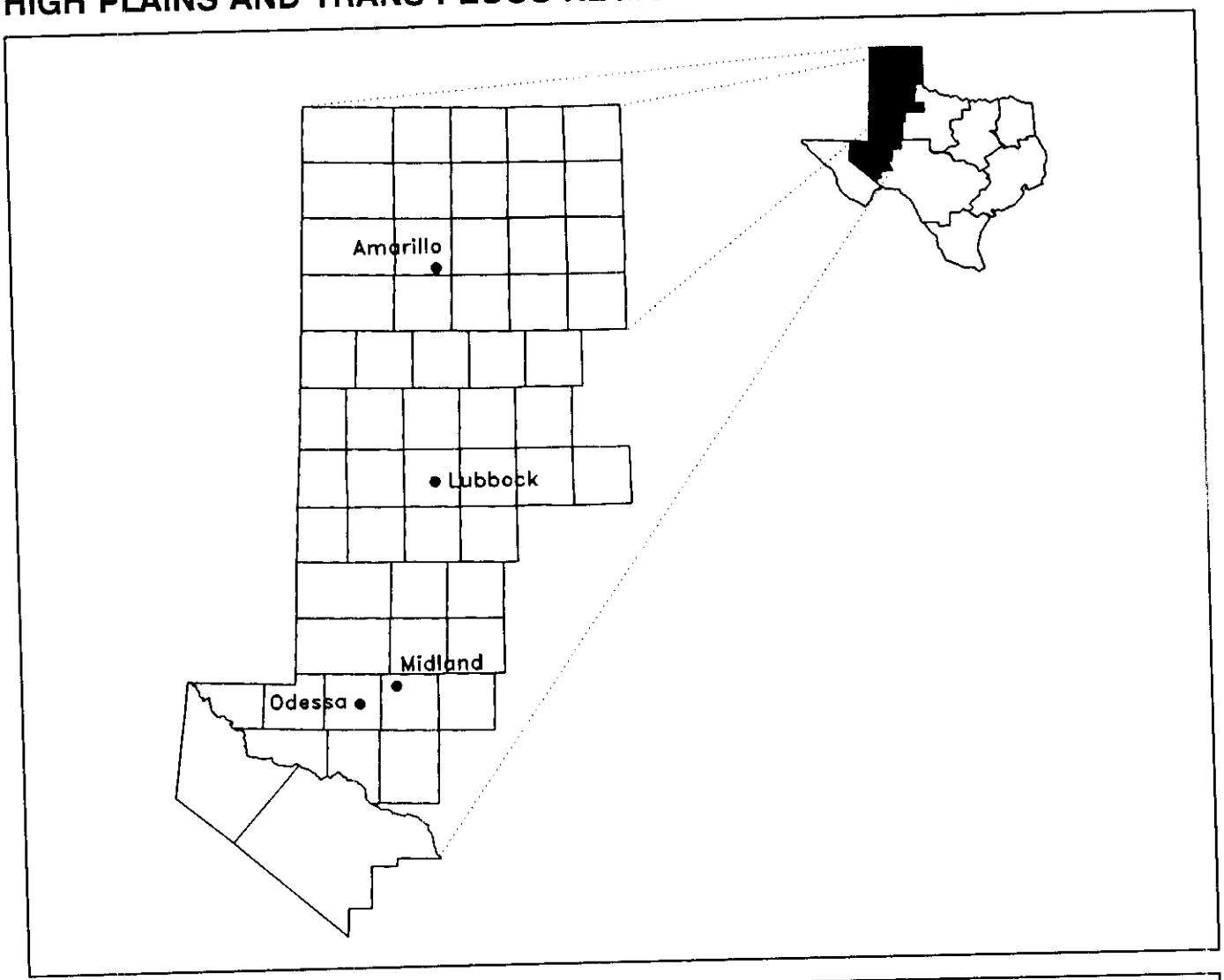


FIGURE 3-15
REGIONAL DISTRIBUTION OF PROJECTED WATER AND WASTEWATER PUBLIC INFRASTRUCTURE COSTS, 1990-2040

HIGH PLAINS AND TRANS-PECOS REGION



CHARACTERISTICS OF THE REGION
THAT AFFECT WATER SUPPLY AND DEMAND

POPULATION :	1990	1.160 million
	2000	1.273 million
	2010	1.399 million
	2020	1.575 million
	2030	1.797 million
	2040	1.921 million

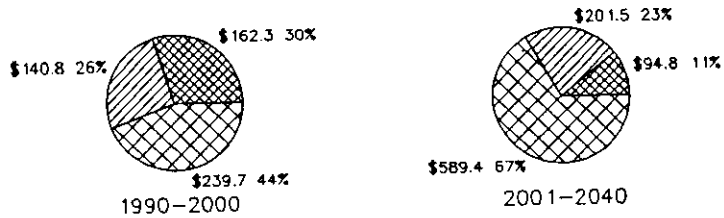
MAJOR ECONOMIC SECTORS: Agriculture, Agribusiness, Mineral Production, Manufacturing, Retail and Wholesale Trade

NORMAL ANNUAL PRECIPITATION: 10 to 22 inches

ANNUAL NET EVAPORATION RATE: 53 inches

PHYSICGRAPHY: In the High Plains, level plains with escarpment boundary on South and Southeast transcending to the Trans-Pecos area of arid, flat plains rising to high mountains.

COST DISTRIBUTION OF IDENTIFIED
REGIONAL WATER-RELATED PUBLIC FACILITY NEEDS
(mill. $)



Currently Identified Flood Protection
Needs Total $7.3 Million.

HIGH PLAINS AND TRANS-PECOS REGION

Regional Description. The High Plains and Trans-Pecos Region is comprised of 56 counties located in the Canadian River Basin and portions of the Red, Brazos, Colorado, and Rio Grande basins. In 1980, the regional population totaled 1.08 million residents, with the counties of Lubbock, Potter, Midland, Ector, and Randall accounting for more than 54 percent of the total population. The regional population is currently estimated at 1.15 million residents. By the year 2040, population of the region is projected to range between 1.67 and 1.92 million residents. The major population centers of the region are the cities of Lubbock, Amarillo, Odessa, Midland, Big Spring, Plainview, Pampa, Borger, Hereford, and Levelland.

Total annual water use within the region is about 4 million acre-feet, with water used for irrigation purposes accounting for almost 90 percent of total use. The current water use pattern is not expected to change drastically over the 50-year planning period. The projected decline in regional irrigation water requirements is reflective of reduction in irrigated acreage and anticipated improvements in water efficient irrigation equipment and management practices. With the implementation of municipal water use conservation programs and practices, annual municipal water savings are projected to reach 21,700 acre-feet by the year 2000, and about 65,000 acre-feet by the year 2040.

Regional Water-related Problems and Needs. The Ogallala (High Plains) Aquifer is the major source of municipal and irrigation water. Historically, pumpage of ground water from this water-bearing formation has exceeded the natural recharge of the resource resulting in declining water levels. However, some parts of the Ogallala Aquifer have experienced water-level rises over the past five years. Currently, the Ogallala supplies irrigation water to about 4.0 million acres in the Texas High Plains. By the year 2040, it is projected that the Ogallala will supply irrigation water to about 3.8 million acres. Without an effective water conservation program, the region could need about 4.5 million acre-feet per year of water to irrigate the 3.8 million acres. However, an effective water conservation program could reduce the water requirements to about 3.1 million acre-feet per year of water. Even with conservation, water needs for irrigation could exceed supplies in localized areas of the region. Ground water in many areas has higher fluoride and nitrate concentrations than the U.S. Environmental Protection Agency and the State allow for public consumption under the Federal Safe Drinking Water Act. Additionally, localized flooding is a problem throughout the region due to the topography of the area.

The percent distribution of the estimated $1.429 billion in projected total costs for identified water and wastewater infrastructure in the High Plains and Trans-Pecos Region over the 50-year planning period is shown in the inset box at left. Approximately $543 million would be required in the first ten years and an estimated $886 million in the remaining 40 years of the planning period.

Local Water-related Problems and Needs. A brief narrative of the Board's evaluation of the water resources situation of major urban areas and large utility suppliers in the High Plains and Trans-Pecos Region is described below. Additional information may be obtained from the Board's files.

The Canadian River Municipal Water Authority. The Canadian River Municipal Water Authority (CRMWA) has a permit to divert 103,000 acre-feet per year from Lake Meredith; however, supplies available are estimated to be about 80 percent of the permit. The long-range estimate of supplies, assuming additional water resource development by New Mexico, is about 50 to 60 percent of the permitted diversion depending upon the results of litigation by Texas and Oklahoma against the State of New Mexico for alleged compact violations. The CRMWA's reservoir has water quality problems and sometime in the future could be out of compliance with State Health Department and the federal Safe Drinking Water Act standards. To ensure the water quality of Lake Meredith, the Authority and the U.S. Bureau of Reclamation have proposed the construction of a salinity control project near Logan, New Mexico to reduce the discharge of highly mineralized water into the Canadian River.

Colorado River Municipal Water District. The Colorado River Municipal Water District (CRMWD) has surface water supplies in Lake J.B. Thomas, Lake E.V. Spence, the recently constructed O.H. Ivie Reservoir, and well fields in Martin, Ector, Ward, Howard, Glasscock, and Scurry counties. The CRMWD also provides water quality enhancement by diverting low

streamflows with high salinity to side storage. These diversion points are located on the Colorado River near Colorado City, on Beals Creek near Big Spring, and on Three and Four Mile Lakes. Additionally, the CRMWD will begin construction on a $7 million water quality enhancement project in Mitchell County during 1990. Member cities of the District include Odessa, Snyder, and Big Spring. Over the 50-year planning period, the District is not expected to add new sources of surface water supply but will provide transmission facilities related to the new O.H. Ivie Reservoir project. The District will develop additional ground-water supplies during the planning period and will continue its policy of conjunctive use of ground- and surface water assets.

City of Amarillo. The City is supplied water by the Canadian River Municipal Water Authority and well fields in Carson, Deaf Smith, and Randall counties. The City uses the well fields for water supply and to reduce total dissolved solids (TDS) concentrations of Lake Meredith water. The City plans to continue use of the Carson well fields and develop additional well fields; however, the water supply from these well fields could be limited by the Panhandle Underground Water Conservation District. Additionally, the City has water right holdings in Hartley County which are planned for development over the next 20 to 30 years. Based on the existing and developable supplies, in conjunction with an effective water conservation program, the City is expected to meet its future water needs through the year 2040.

The City of Amarillo has two major wastewater treatment facilities, the River Road plant serving much of the City in Potter County and the Hollywood Road plant serving sections of the City in Randall County. The City is planning a major expansion at the Hollywood Road site in the near future.

In a high flood hazard study completed in September 1986, the U.S. Army Corps of Engineers identified enforced zoning as the most recommended flood damage prevention measure for the playa lakes and creeks in and around Amarillo.

City of Lubbock. The City's primary source of water is from Lake Meredith (CRMWA) and well fields located in Lubbock, Bailey, and Lamb counties. Lake Alan Henry, presently under construction by the City and the Brazos River Authority at an estimated cost of $50 million, is expected to be operational by early 1993 and, with completion of diversion, transmission, and treatment facilities, should provide the City with an additional 29,000 acre-feet per year. Between the years 2030 and 2040, the City is expected to need additional water supplies from the permitted Post Reservoir Project. Based on the existing and developable supplies, in conjunction with an effective water conservation program, the City is expected to meet its future water needs through the year 2040.

The City's Southeast Water Reclamation Plant (SEWRP), permitted to treat 25 million gallons per day (MGD), handles nearly all of the City's wastewater flow. Treated effluent is used as either makeup water for the Southwestern Public Service Company's Jones Power Plant, or for irrigation on over 7,000 acres of farm land at various sites. The City is planning expansion and major upgrading at the SEWRP.

A recently completed flood protection planning contract, sponsored by the Board, proposed a number of structural improvements, relating to additional flood storage in the playa lakes, along with encouragement of the purchase of additional flood insurance by citizens residing within the 100-year floodplain.

City of Midland. Currently, the City of Midland is supplied water from the Colorado River Municipal Water District, and the City's Paul Davis and McMillan well fields. The City has also purchased approximately 16.54 percent of the water supply from the recently completed O. H. Ivie Reservoir. With the completion of transmission facilities from the reservoir, additional water supplies of about 18,690 acre-feet per year will be available to the City. The existing and planned transmission facilities, in conjunction with an effective water conservation program, are expected to meet the City's future water needs through the year 2040.

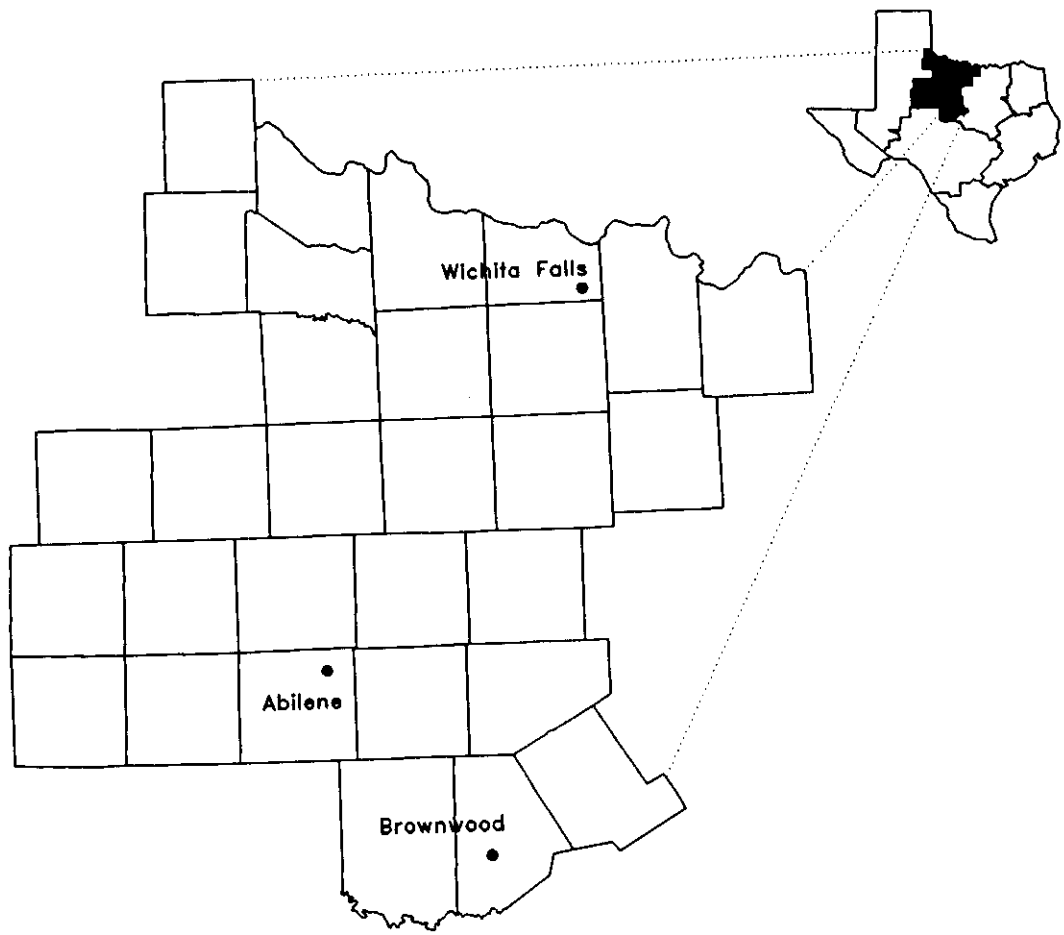
Midland is currently served by a 15 MGD wastewater treatment and land application system that utilizes area golf courses and two irrigation sites totalling more than 6,000 acres. A second treatment facility serving the regional airport will be abandoned upon completion of a planned trunk line.

City of Odessa. The City of Odessa, a member city of the Colorado River Municipal Water District, receives both ground water and surface water from the District. With the recently completed O. H. Ivie Reservoir, proposed construction of water

transmission facilities, and an effective water conservation program, the City is expected to meet its future water needs through the year 2040.

The City of Odessa operates two wastewater treatment facilities, the 9.5 MGD South Dixie Water Reclamation Plant and the 5.2 MGD East Water Reclamation Plant. Approximately 40 percent of the treated wastewater from the South Dixie plant is reused by area industry. Future alternatives appear to be to expand the reuse system or to upgrade treatment levels for discharge to Monahans Draw.

WEST CENTRAL TEXAS REGION



CHARACTERISTICS OF THE REGION
THAT AFFECT WATER SUPPLY AND DEMAND

POPULATION :	1990	0.540 million
	2000	0.616 million
	2010	0.694 million
	2020	0.793 million
	2030	0.911 million
	2040	0.977 million

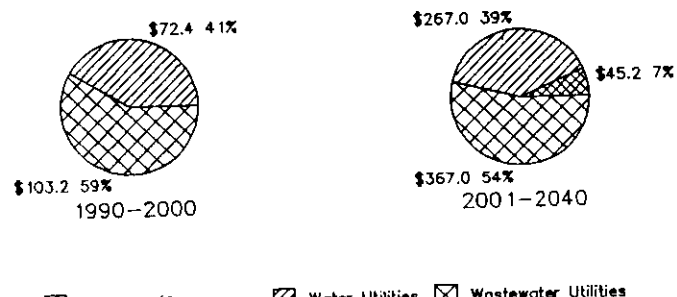
MAJOR ECONOMIC SECTORS: Mineral Production, Agriculture, Agri-business, Manufacturing, Retail and Wholesale Trade, Government

AVERAGE ANNUAL PRECIPITATION: 19 to 30 inches

ANNUAL NET EVAPORATION RATE: 51 inches

PHYSIOGRAPHY: Rolling prairies in the western portion transcending to the flat, relatively treeless, grand prairie and cross timber country in the east

COST DISTRIBUTION OF IDENTIFIED
REGIONAL WATER-RELATED PUBLIC FACILITY NEEDS
(mill. $)



Currently Identified Flood Protection
Needs Total $64.7 Million

WEST CENTRAL TEXAS REGION

Regional Description. The West Central Texas Region consists of 30 counties located in portions of the Red, Brazos, Colorado, and Trinity river basins. In 1980, the population of the region totaled 518,900 residents, of which 51 percent of the regional population was located in the counties of Wichita, Taylor, and Brown.

Currently, the population of the region is estimated at 537,200 residents. By the year 2040, the population of the region is projected to range between 837,200 and 977,200 residents. The major population centers within the West Central Texas Region are the cities of Abilene, Wichita Falls, Brownwood, Snyder, Vernon, Sweetwater, Burkburnett, Graham, Breckenridge, and Iowa Park.

The West Central Texas Region's current water use is about 337,000 acre-feet per year, of which water used for farm irrigation purposes accounts for approximately 55 percent of this total. The current water use pattern of the region is projected to change over the 50-year planning period as municipal and manufacturing water requirements are projected to increase by more than 63 percent above current water use levels, while irrigation water requirements are projected to remain relatively stable during this time.

Agricultural irrigation water requirements are projected by the Board to remain the major water demand category of the region over the next 50 year planning period. Irrigation demands placed on water resources of the region are, however, expected to diminish over time and ultimately account for only about 51 percent of the regional water demand by the year 2040.

Municipal water requirements of the region are projected to increase by more than 54 percent above the current municipal water use by the year 2040. With the implementation of various municipal conservation programs and practices by cities in the region, savings in annual water requirements are projected by the Board to reach about 10,000 acre-feet by the year 2000, increasing further to approximately 31,500 acre-feet of savings by the year 2040.

Regional Water-related Problems and Needs. Natural salt pollution in the upper reaches of the Red and Brazos river basins precludes the full utilization of the water resources of these basins. Also, leaking oil, gas, and saltwater disposal wells, along with improper disposal of saltwater incidental to oil and gas exploration and production, have resulted in localized contamination of fresh ground- and surface water supplies.

High nitrate concentrations occur in the ground water in some areas in the West Central Texas Region due to naturally-occurring phenomena, locally intensified by contaminants from septic tanks, cesspools, feedlots, agricultural fertilizers, and cultivation practices. Locally, ground water is higher in fluoride concentrations than existing State standards for public consumption under the Federal Safe Drinking Water Act.

Brush infestation of rangeland and growth of woody plant species that obtain water directly from the water table or from the soils just above it (phreatophytes) compete with more useful plants for available fresh water supplies. Due to the topography of the area, localized flooding in the region is also a continuing problem.

The percent distribution of the estimated $855 million in projected total facilities costs for identified water and wastewater infrastructure in the West Central Texas Region over the Board's 50-year planning period is shown in the inset box at left. Approximately $176 million of spending for these facilities would be required in the first 10 years, with an estimated $679 million in the remaining 40 years of the planning period.

Local Water-related Problems and Needs. A brief narrative of the Board's evaluation of the water resources situation of major urban areas and large utility suppliers in the West Central Texas Region is described in the narrative below. Additional information on the utility demands, facility needs, and problems of these West Central Texas communities and utilities may be obtained from the Board's files upon request.

City of Abilene. The City of Abilene is supplied from Lakes Abilene and Fort Phantom Hill, as well as the West Central Texas Municipal Water District (WCTMWD). The City has a current raw water supply capacity of approximately 36,400 acre-feet per year. The District owns the Hubbard Creek Reservoir and has contracted to provide the City of Abilene with water delivered into Lake Fort Phantom Hill. The water transmission lines to the Lake can provide approximately 17,500 acre-feet per year of supply on the average.

The West Central Municipal Water District, on behalf of the City of Abilene, is participating in the new O.H. Ivie Reservoir Project, located at the confluence of the Colorado and Concho rivers in the Colorado River Basin. The City is entitled to 16.54 percent of the projected firm yield of the new supply project. Major water transmission facilities from the new water supply reservoir will need to be constructed by the City of Abilene by the year 2010. Existing and planned water supplies and an effective water conservation program by the City, are expected to provide sufficient water supplies to meet the future needs of the City and its customers through the year 2040.

All of the City of Abilene's collected wastewater is pumped by the City's Buck Creek Pump Station to the Hamby Water Reclamation Plant (WRP). The City has recently funded improvements to both of these wastewater facilities and to the major upstream trunk interceptor. Municipal capital improvement plans call for expanding the Hamby WRP from 13.4 MGD to 18 MGD, expanding the trunk interceptor system, and may include a new Westside wastewater treatment plant.

The U.S. Army Corps of Engineers has identified over $37 million of flood protection projects, along with a variety of non-structural protection measures, including enforced zoning, permanent evacuation of the floodplain, early warning systems, and flood proofing, to address the area flooding problems in the urbanized Elm Creek watershed.

City of Wichita Falls. The City of Wichita Falls presently draws water supplies from the Kickapoo and Arrowhead Reservoirs. Wichita Falls' present water supply system can provide about 63,000 acre-feet per year, and the City also has water rights to over 70,000 acre-feet per year in Lake Kemp. The City provides water to various water supply corporations serving the rural areas near Wichita Falls. The City's existing water supplies, in conjunction with the implementation of an effective water conservation program, are expected to provide sufficient water to meet the City's future municipal water needs through the year 2040.

The City of Wichita Falls is in the final engineering design stages of a $21.3 million State Water Pollution Control Revolving Fund loan project to upgrade its River Road wastewater treatment plant. The wastewater improvement project will raise the average hydraulic flow capacity of the plant from 17 MGD to 19.91 MGD and will provide for higher levels of treatment.

Studies by the U.S. Army Corps of Engineers have identified over $9 million of construction programs to alleviate chronic flooding problems on McGrath Creek, and has recommended the implementation of both enforced zoning by the City and various other non-structural flood prevention measures along Holliday, McGrath, and Plum creeks, as well as the Wichita River.

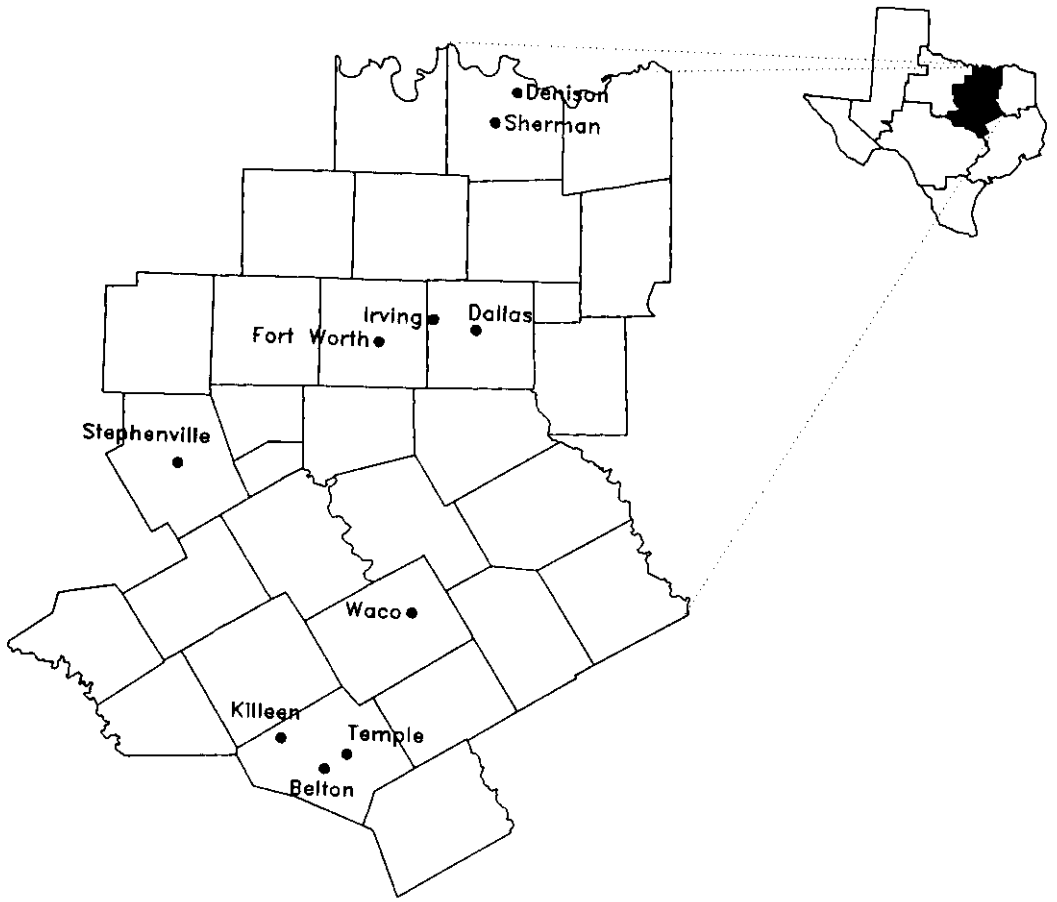
City of Brownwood. The City of Brownwood receives water from Lake Brownwood, which is owned and operated by the Brown County Water Improvement District No. 1. The City's water supply needs are expected to double over the 50-year planning horizon. With the City's existing water supplies and an effective municipal water conservation program, Brownwood is expected to have sufficient water supplies to meet its future water needs through the year 2040.

Brownwood recently completed construction of an upgraded 3.6 MGD wastewater treatment facility. Projected municipal population increases will likely require future expansion of the City's treatment facilities.

Brownwood suffers from severe recurrent flooding, as evidenced by the tragic Spring floods of 1990, which was the sixth significant flood event in the City since 1972. The Pecan Bayou reservoir was authorized by Congress in 1968 for flood control and water supply

purposes, but it is currently considered to have an inactive status. The U.S. Army Corps of Engineers has requested additional FY1990 appropriations funding to re-evaluate the project at full federal expense.

NORTH TEXAS REGION



CHARACTERISTICS OF THE REGION
THAT AFFECT WATER SUPPLY AND DEMAND

POPULATION :		
	1990	4.940 million
	2000	5.778 million
	2010	6.640 million
	2020	7.452 million
	2030	8.283 million
	2040	8.871 million

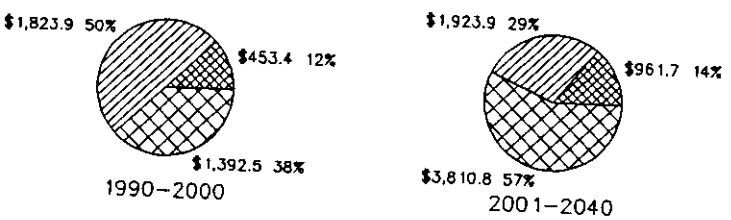
MAJOR ECONOMIC SECTORS: Manufacturing, Retail and Wholesale Trade, Finance, Services, Transportation, and Tourism

AVERAGE ANNUAL PRECIPITATION: 26 to 40 inches

ANNUAL NET EVAPORATION RATE: 41 inches

PHYSIOGRAPHY: Transcending from flat to rolling wooded cross timbers in the west to wooded rolling hills and flat lands of the Blacklands and Post Oak Belt.

COST DISTRIBUTION OF IDENTIFIED
REGIONAL WATER-RELATED PUBLIC FACILITY NEEDS
(mill. $)



Reservoir/Conveyance Water Utilities Wastewater Utilities

Currently Identified Flood Protection
Needs Total $144.1 Million

NORTH TEXAS REGION

Regional Description. The North Texas Region consists of 31 counties located predominately in the Trinity and Brazos River Basins and in portions of the Red, Sulphur, and Sabine river basins. In 1980, the population of the region totaled 3.78 million people, with about 64 percent of the regional population located in Dallas and Tarrant counties. Currently, the regional population is estimated at 4.68 million residents. By the year 2040, population of the region is projected to range between 7.7 and 8.9 million residents. The major population centers of the region are the cities of Dallas, Fort Worth, Arlington, Garland, Irving, Plano, Waco, Grand Prairie, Mesquite, and Richardson.

Total current annual water use within the region is about 1,195,000 acre-feet. Due to the large concentration of population within the region, municipal water use is by far the largest water use category, accounting for more than 77 percent of the region's annual water use. The current water use pattern of the region is not expected to change significantly over the 50-year planning period with municipal water requirements continuing to be the largest water use category in the region. With water use conservation programs and practices in place, annual municipal water savings are projected to reach about 96,000 acre-feet by the year 2000, increasing to more than 285,000 acre-feet by the year 2040.

Regional Water-related Problems and Needs. Ground-water levels in the Trinity Aquifer have been lowered severely, resulting in burdensome pumping costs that will increase. The quality of ground water is deteriorating as water levels decline. Fluoride concentrations in ground water are high. In the southern portion of the region, the northern segment of the Edwards Aquifer (which has no ground-water district supervision) provides water to rural and urban areas. Surface water quality suffers from high urban use pressures (dissolved oxygen, suspended solids, phosphates, fecal coliform, algal blooms, and aquatic plants) and runoff from some agricultural areas. High chloride concentrations in Lake Texoma in the Red River Basin and reservoirs in the middle Brazos River Basin preclude full utilization of the water resources of these basins. Surface water development is near the maximum potential for the Upper Trinity River Basin. Water is being imported from neighboring basins to the east. Regional initiatives to address watershed management and water conservation are underway in the Upper Trinity Basin area. Severe flooding is also a problem in the Upper Trinity Basin area. A major regional flood protection study, termed the "Common Vision for the Trinity Corridor," is underway at present to examine structural and non-structural means of addressing this problem.

The percent distribution of the estimated $10.366 billion in projected total costs for identified water-related infrastructure in the North Texas Region over the 50-year planning period is shown in the inset box at left. Approximately $3.670 billion would be required in the first 10 years and an estimated $6.696 billion in the remaining 40 years of the planning period.

Local Water-related Problems and Needs. A brief narrative of the Board's evaluation of the water resources situation of major urban areas and large utility suppliers in the North Texas Region is described below. Additional information may be obtained from the Board's files.

Tarrant County Water Control and Improvement District No. 1. The District (TCWCID #1) presently owns and operates Eagle Mountain, Bridgeport, Cedar Creek, and Richland-Chambers Reservoirs and storage in Benbrook Reservoir. TCWCID #1 supplies water to Fort Worth, Arlington, Mansfield, communities throughout Tarrant County, and communities adjacent to the District's reservoirs. The District also provides raw water to the Trinity River Authority, who then sells treated water to the cities of Bedford, Euless, North Richland Hills, Grapevine, and Colleyville. The District will serve to augment the raw water supplies of Weatherford and Benbrook in the future. The District's total supply is estimated to be over 457,000 acre-feet per year.

By the year 2030, the District will have to develop additional supplies to meet its customers needs. It is recommended that the District develop the Trinity River Diversion into existing Richland-Chambers and Cedar Creek reservoirs to make expanded use of those facilities, eventually construct the Tehuacana Reservoir project, and build associated transmission facilities to convey supplies associated with both projects. If the diversion is built but the Board's

projected conservation savings are not realized, then water supply could be obtained from the Parkhouse II or Marvin Nichols reservoirs depending on regional cooperation and status of potential land use conflicts. However, if the Trinity River Diversion proves infeasible, additional supplies would likely be provided from the potential Marvin Nichols project in the Sulphur Basin.

North Texas Municipal Water District. Over three-quarters of a million people depend on the District for water supplies. The District's service area covers over 1,600 square miles, and it currently supplies over 189,000 acre-feet of water per year. The District's supply sources include: Lake Lavon, Lake Texoma, and Lake Cooper, presently under-construction. The District also provides wastewater treatment and solid-waste disposal for its customer cities. In the future, the District will need to develop the New Bonham Reservoir site and associated transmission facilities and purchase additional water supplies from Cooper Reservoir.

The District owns and/or operates regional and subregional wastewater conveyance and treatment facilities in Collin, Dallas, and Rockwall counties. It has recently expanded its Wilson Creek treatment facility serving Plano, McKinney, and Allen, and is planning further expansion in this system as well as in those serving the cities of Wylie, Mesquite, and Rockwall.

Greater Texoma Water Authority. The Authority has rights in Lake Texoma and is developing diversion facilities in conjunction with the North Texas Municipal Water District. The Authority will provide water to the Sherman-Denison area and has rights to about 69,000 acre-feet per year in Lake Texoma.

Brazos River Authority. The Brazos River Authority (BRA) owns or operates 12 major reservoirs on the Brazos River and its tributaries. Supplies from Lakes Granbury, Proctor, Aquilla, Waco, Belton, and Stillhouse Hollow are used in this region. Supplies from Lakes Possum Kingdom and Whitney are also supplied by the BRA to meet needs in the North Texas Region. The Authority will need to add to its surface water supplies by developing the South Bend project if projected municipal water conservation savings are not realized.

The Brazos River Authority owns two regional wastewater treatment facilities, one serving the Waco metropolitan area and the other serving the cities of Temple and Belton. The Waco treatment plant has a capacity of 37.5 MGD. The Authority has completed construction on an expansion of the Temple-Belton facility from 5 MGD to 10 MGD.

City of Dallas and Dallas Water Utilities. The Dallas Water Utilities (DWU) provides treated water to 22 political subdivisions and 7 raw water customers in Dallas, Denton, and Collin counties. DWU has water permits in Ray Hubbard, Lewisville, Ray Roberts, Grapevine, Palestine, Tawakoni, and Lake Fork Reservoirs. Total available supplies are more than 650,000 acre-feet per year. The DWU also purchases about 10,000 acre-feet per year from North Texas Municipal Water District.

Based on the Utilities' existing water supplies, construction of planned transmission facilities to Lakes Palestine and Lake Fork, and implementation of effective water conservation programs by DWU and its customer cities, the DWU is expected to meet all future water needs of its many customers through the year 2040. The Board's without-conservation forecast indicates that the potential Parkhouse Reservoir 1 would be needed by 2030. The DWU feels that in view of its existing conservation program, the additional conservation reflected in the Board's projected 15 percent conservation savings is not achievable. The DWU has completed a long-range plan in 1989 that projects only seven percent additional savings could be achieved through expanded conservation efforts and says the DWU will need additional supplies from Parkhouse 1 Reservoir by the year 2030.

Dallas Water Utilities operates two of the largest wastewater treatment facilities in Texas, the 150 MGD Dallas Central Plant and the recently expanded 90 MGD Southside Plant. The Central Plant is undergoing an extensive upgrading and modernization program. The Southside Plant is undergoing a number of improvements, primarily in the area of sludge management. In the longer term, Dallas will expand Southside to 150 MGD.

The City of Dallas and the surrounding areas continue to experience significant damage from flooding. Several studies have identified over $5 million of structural improvements for flood protection in the Dallas floodway, along with numerous non-structural flood damage prevention measures.

City of Fort Worth. The City of Fort Worth is the second most populated city in the region and is provided water by the Tarrant County Water Control and Improvement District # 1 (TCWCID #1). With the development of additional surface water supplies by the TCWCID #1, and an effective water conservation program, the City's future water needs are anticipated to be met by the TCWCID #1 through the year 2040.

The City's Village Creek wastewater treatment plant serves 24 neighboring cities in Tarrant and Johnson counties. The City has embarked on a series of projects that will expand Village Creek from 120 MGD to 144 MGD.

Two recent studies in the Fort Worth area have identified numerous non-structural flood damage prevention measures, along with some minor structural improvements in the Edgecliff Branch of Sycamore Creek.

Trinity River Authority. The Trinity River Authority (TRA), through a contract with TCWCID #1, provides water to the cities of Bedford, Euless, North Richland Hills, Grapevine, and Colleyville. TRA is the local sponsor of Joe Pool Reservoir and has contracted to provide water to the cities of Cedar Hill, Duncanville, Grand Prairie and the Midlothian Water District from the project. TRA, through Lakes Bardwell and Navarro Mills, also provides water to the cities of Corsicana, Waxahachie, and other communities in Ellis County. TRA could additionally be the local sponsor for any flood control or water quality protection projects developed in the upper, middle, or lower Trinity Basin. The potential Tennessee Colony Reservoir in the middle Trinity Basin could provide substantial flood control protection for the lower part of the basin, although acceptable federal, state, and/or local funding mechanisms would be necessary to support the cost of this expensive facility.

The TRA is the state's largest operator of regional treatment works. The Central Plant and interceptor system services 19 cities in the "mid-cities" area of Dallas and Tarrant counties, including portions of Fort Worth, Dallas, and the D/FW Airport. TRA recently awarded a $104 million contract to expand the Central Plant from 115 MGD to 135 MGD. The Ten Mile Creek system, recently expanded from 6.78 MGD to 21.5 MGD, serves 6 cities in southern Dallas and Ellis counties. The Red Oak Regional System, presently under construction, which will expand regional service to six cities in Dallas and Ellis County. In addition, the TRA is completing construction of the first phase of a regional system on Denton Creek in southern Denton County. When Red Oak and Denton Creek are complete, the TRA will be treating wastewater from more than 30 cities in a four county area.

Sherman-Denison. The City of Sherman's water needs are currently being met from ground-water supplies; however, the City plans to convert to surface water supplies with the completion of diversion and treatment facilities by the Greater Texoma Water Authority. The City of Denison is presently supplied water from Lake Randall and Lake Texoma, and the City plans to continue to use these supply sources through the foreseeable future. Based on existing water supplies, planned water source conversion, and an effective water conservation program for both cities, the future water needs for the cities of Sherman and Denison are anticipated to be met through the year 2040.

Sherman completed construction of a major upgrade to its 12 MGD Post Oak Creek wastewater treatment facility in 1987. Denison operates three treatment facilities with a combined capacity of 6.4 MGD. The City recently consolidated the operations of two plants in an expanded 4 MGD Paw Paw Creek plant.

A Corps of Engineers high flood hazard area study conducted in Sherman, sponsored by the Board, and completed in September 1986 identified the need for additional flood damage prevention measures, mainly consisting of enforced zoning in Choctaw, Post Oak, and Sand Creeks, as well as several unnamed creeks in and around the Sherman area.

Upper Trinity Regional Water District. The District was created by the Texas Legislature in June, 1989 to provide regional water and wastewater services for the Denton County area. The service area of the District is within the water supply planning boundaries of the City of Dallas Water Utilities. Since Dallas has planned future water supplies for most of Denton County, the District will obtain from Dallas Water Utilities a substantial portion of its water supply requirements.

The long range plan for the District recommends consideration of joint development of water resources with others in the Sulphur River Basin. Consistent with that plan, the District has made a contract with the City of Commerce to supplement Dallas water by

temporary use of Commerce's water supply from Cooper Reservoir. Implementation of that agreement is pending a determination of transmission feasibility to Denton County and approval of the temporary interbasin transfer. The District has executed long-term agreements with 10 cities and utilities in Denton County to develop a surface water system with water treatment plant and transmission facilities to each of the contracting entities. For many of the participating entities, this project will be the first step away from total reliance on limited ground-water resources.

City of Denton. The City of Denton currently obtain surface water supplies from Lewisville and Ray Roberts Reservoirs. Total available supply for the City from the two reservoirs is estimated at over 38,000 acre-feet per year. The City and its customer cities are expected to need additional supplies before the year 2030. The Upper Trinity Municipal Water District or the Dallas Water Utilities could provide these additional water needs. With these additional water supplies and an effective water conservation program, the City is anticipated to be able to meet its future water needs through the year 2040.

Denton currently operates a 12 MGD wastewater treatment facility that discharges to Pecan Creek. The City intends to expand the plant in stages to approximately 20 MGD by the year 2010.

City of Waco. The City of Waco is currently supplied water from Lake Waco, which is operated for the City by the Brazos River Authority. It is anticipated that Waco and BRA will provide water from Lake Waco to other cities and rural areas in McLennan County. The Waco project is presently permitted to supply about 58,000 acre-feet per year; however, a permit application has been submitted by the BRA to reallocate authorized storage in the reservoir to municipal supply. Operating the reallocated Lake Waco with the planned Bosque Reservoir as a system could provide the Authority with over 99,000 acre-feet per year of additional supplies. The Authority plans to use the additional supplies to meet the needs in the Waco area and for other systemwide needs.

The City contracts for wastewater treatment at BRA's Waco Metro Regional Plant and will continue to use the facility in the future.

Killeen-Belton-Temple. The Killeen, Belton, and Temple metropolitan areas are supplied water from Belton Reservoir which is operated by the Brazos River Authority. The City of Temple has contracted for up to 26,700 acre-feet per year of water supply from Belton Reservoir. The City of Belton is supplied by Bell County WCID #1, who has contracts for about 47,600 acre-feet per year from Belton Reservoir. The City also has contracted with the BRA to be supplied up to 2,500 acre-feet per year from Belton Reservoir. The City of Killeen is also supplied by Bell County WCID #1. Using BRA's existing water supplies and an effective water conservation program, the cities are anticipated to be able to meet their future water needs through the year 2040.

The City of Killeen's wastewater treatment is handled by Bell County WCID#1 at its 21 MGD regional plant. The plant also provides treatment for Fort Hood. Belton and Temple contract with the Brazos River Authority for treatment at its regional treatment site. Temple also operates its own 5 MGD Doshier Farms wastewater treatment plant, where extensive rehabilitation is anticipated.

City of Irving. The City is currently supplied by Dallas Water Utilities (DWU); however, the City has contracted for use of 40,260 acre-feet per year of supply from the Cooper Reservoir which is currently under construction. The City is planning to develop transmission facilities in conjunction with North Texas Municipal Water District to deliver water to Irving. The City will also continue to need supplies from DWU. Using DWU's existing water supplies, and the City's supply in Cooper in conjunction with an effective water conservation program, the City is anticipated to be able to meet its future water needs through 2040.

Irving contracts with the Trinity River Authority for wastewater treatment at the Authority's Central Plant.

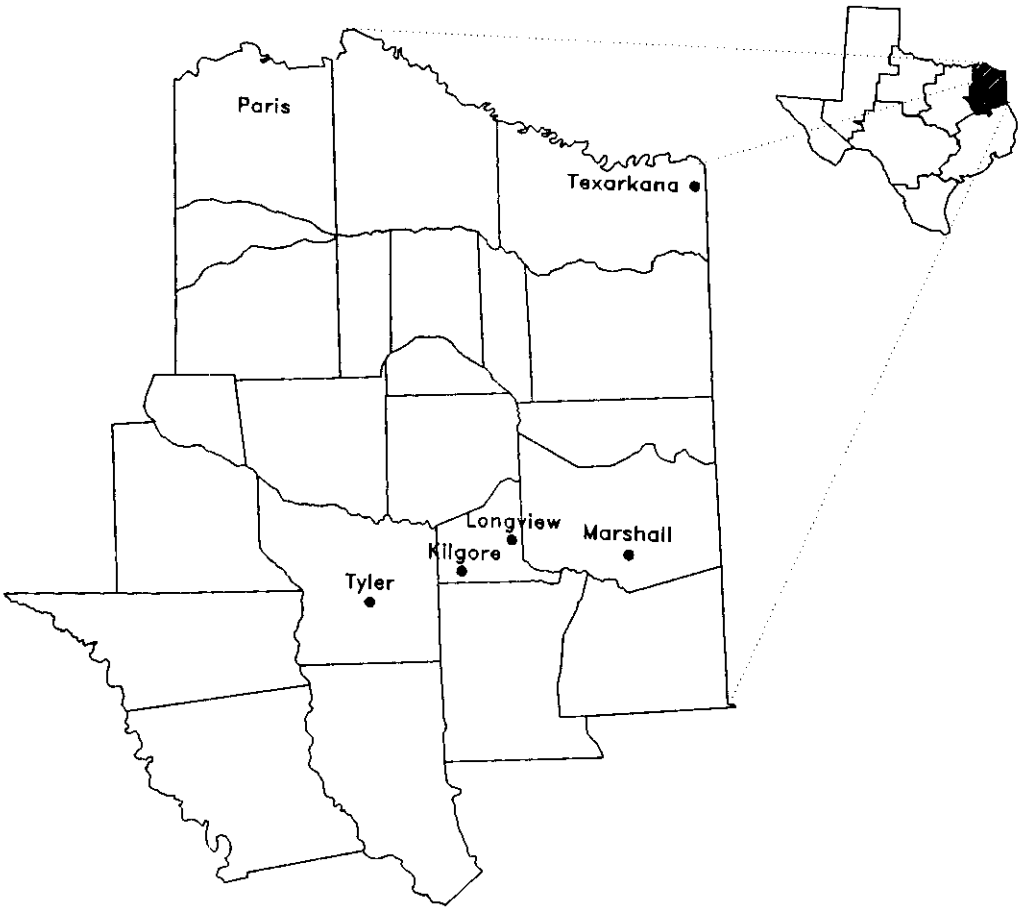
Recently-completed flood studies for the City of Irving have identified modest structural improvements along Delaware Creek and recommended flood damage prevention measures, including enforced zoning, warning systems, and permanent evacuation of certain areas along Cottonwood Branch, Delaware Creek, Estelle Creek, Grapevine Creek, Hackberry Creek, and Long Branch.

The City of Stephenville. The City currently withdraws water from the Trinity Aquifer; however, it has experienced water supply problems due to declining water levels. The City has contracted with Somerville County Water Authority to purchase water from the permitted Paluxy Reservoir project, which is presently

in litigation to establish releases for instream flow needs. With the ultimate development of the Paluxy Reservoir and an effective water conservation program, the City is anticipated to be able to meet its future water needs through the year 2040.

Stephenville is presently served by a 1.85 MGD wastewater treatment facility. The City is anticipating an $8.5 million project to expand capacity to 3 MGD, upgrade treatment levels, and repair and expand its wastewater collection system.

NORTHEAST TEXAS REGION



CHARACTERISTICS OF THE REGION
THAT AFFECT WATER SUPPLY AND DEMAND

POPULATION :	1990	0.940 million
	2000	1.109 million
	2010	1.245 million
	2020	1.418 million
	2030	1.618 million
	2040	1.730 million

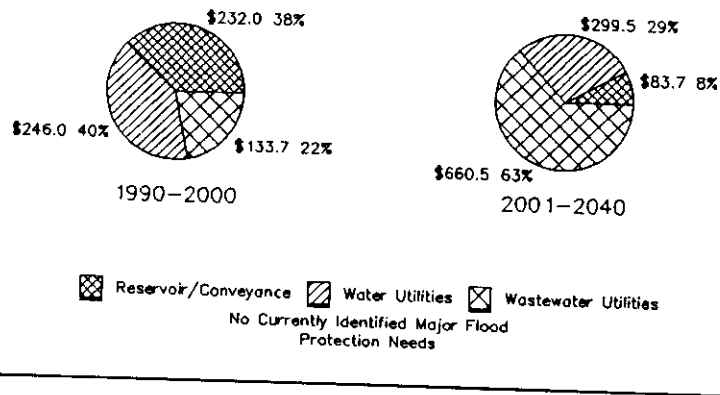
MAJOR ECONOMIC SECTORS: Manufacturing, Wholesale and Retail Trades, Services, Mineral Production, Agriculture, and Agri-business

AVERAGE ANNUAL PRECIPITATION: 42 to 48 inches

ANNUAL NET EVAPORATION RATE: 20 inches

PHYSIOGRAPHY: Flat wooded areas to densely-wooded rolling hills and river valleys

COST DISTRIBUTION OF IDENTIFIED
REGIONAL WATER–RELATED PUBLIC FACILITY NEEDS
(mill. $)



NORTHEAST TEXAS REGION

Regional Description. The Northeast Texas Region consists of 23 counties located in portions of the Red, Sulphur, Cypress, Sabine, Trinity, and Neches river basins. In 1980, the population of the region totaled 806,600 people, with the counties of Smith, Gregg, Bowie, and Harrison accounting for about 44 percent of the regional population. Currently, the population of the region is estimated at 904,600 residents. By the year 2040, population of the region is projected to range between 1.5 and 1.7 million residents. Major population centers of the region are the cities of Tyler, Longview, Texarkana, Paris, Marshall, Palestine, Sulphur Springs, Jacksonville, Kilgore, and Henderson.

Currently, the region's total annual water use is about 539,700 acre-feet. The major water use categories are manufacturing and municipal, almost 77 percent of the total water use of the region. The current regional water use pattern is projected to remain relatively stable over the 50-year planning period as manufacturing, municipal, and steam-electric requirements are projected to remain the major water demand categories of the region. Municipal water requirements are projected to increase about 57 percent above current water use levels by 2040. With implementation of water conservation programs and practices, annual savings in municipal water use are projected to reach about 15,700 acre-feet by the year 2000, increasing further to about 48,600 acre-feet by the year 2040.

Regional Water-related Problems and Needs. In many areas, shallow ground water has high concentrations of iron and is acidic, which makes the water undesirable for municipal use and many manufacturing processes. These problems generally can be solved by completing wells in deeper water-bearing sands or by expensive treatment of water from shallow wells. Surface water and ground-water resources are potentially available to meet projected needs, if projects are planned and developed on schedule. Periodically, dissolved oxygen content in streams is low due to low streamflow and low natural reaeration rates. In many areas of the region, flooding is a major problem.

The percent distribution of the estimated $1.655 billion in projected total costs for identified water-related infrastructure in the Northeast Texas Region over the 50-year planning period is shown in the inset box at left. Approximately $612 million would be required in the first ten years and an estimated $1.043 billion in the remaining 40 years of the planning period.

Local Water-related Problems and Needs. A brief narrative of the Board's evaluation of the water resources situation of major urban areas and large utility suppliers in the Northeast Texas Region is described below. Additional information may be obtained from the Board's files.

Sulphur Municipal Water District. The District owns 26.282 percent of the conservation storage space in the Cooper Reservoir, presently under construction. The District plans to use its share of Cooper to meet needs of its customer cities (Cooper, Commerce, and Sulphur Springs) in the Sulphur Basin. However, there could be excess supplies available from the District's share of Lake Cooper on an interim basis over the next 50 years. The most likely place of use of this water on a temporary, interim basis would be in the Dallas/Ft. Worth metroplex area. In fact, Commerce and the Upper Trinity Regional Water District have entered into an agreement providing for the temporary, interim sale of water from Commerce's share of Lake Cooper to the UTRWD over the next 50 years. This contract has not yet been considered by the Texas Water Commission. There could be excess supplies available for use by the other two owners of the storage of Cooper Reservoir, North Texas Municipal Water District and the City of Irving.

Little Cypress Utility District. The District has a permit for Little Cypress Reservoir. The reservoir could develop about 129,000 acre-feet per year. The District plans to supply the cities of Marshall, Longview, and Kilgore; and Gregg, Harrison, Rusk, and Upshur counties; and the City of Shreveport, Louisiana.

Northeast Texas Municipal Water District. The District owns storage rights in Lake O' the Pines Reservoir and supplies water to industrial and steam-electric plants in the Cypress Creek and Sabine river basins. The District has excess supplies that could be used to meet demands in the Cypress or Sabine basins. The District has requested that the Corps of Engineers perform a reallocation study of flood

control storage to water supply storage on Lake O' The Pines.

Sabine River Authority. The Authority is the owner of three reservoirs in the Sabine River Basin. The Authority has contracted to supply Dallas Water Utilities over 300,000 acre-feet per year from Lake Fork and Tawakoni Reservoirs. The Authority has also entered into an agreement with the San Jacinto River Authority (SJRA) to supply the SJRA up to 672,000 acre-feet per year from Toledo Bend Reservoir.

The Big Sandy project is recommended for development to supply the needs in the upper Sabine Basin. The Authority is attempting to develop the Waters Bluff Reservoir site. However, a federal government non-development environmental easement within the site, which precludes project development without Congressional approval, has been litigated by the Authority and others. The easement was upheld, and an appeal of this decision may be filed. The site could ultimately be a viable site for future water supplies.

Angelina-Neches River Authority. The Authority is the sponsor of the proposed Lake Eastex project which could ultimately provide regional water supplies for Smith, Rusk, Cherokee, Nacogdoches, and Angelina counties. Cities in the area, such as Henderson, and other rural water supply utilities are experiencing ground-water supply problems which could be addressed by this regional water system.

City of Tyler. The City's water needs are met from Lake Tyler and from wells into the Carrizo-Wilcox Aquifer. It is anticipated that withdrawals from the aquifer will remain at about present levels, while withdrawals from Lake Tyler will increase. The City also has supplies in Lake Palestine. The City is anticipated to be able to meet it's future water needs through the year 2040 by using the City's present supplies in conjunction with an effective water conservation program.

The City owns two wastewater treatment facilities: the 13 MGD Westside Plant and the 9 MGD Southside Plant. The Westside Plant is under construction to upgrade treatment levels to recently imposed standards by the TWC. A similar project is planned for the Southside Plant.

City of Longview. The City of Longview has supplies in Lakes Cherokee and Lake Fork and has rights to flows in the Sabine River. The City has experienced water quality problems with the flows from the Sabine River. The City is a member of the Little Cypress Utility District and is participating in the development of Little Cypress Reservoir. The City should be able to meet its future water needs through the year 2040 by using its present supplies and supplies from the District in conjunction with an effective water conservation program.

The City of Longview operates a 13.9 MGD wastewater treatment plant. The City has recently completed improvements to this facility, but the City's capital improvement plans indicate an aggressive program of upgrading, modernization, and expansion of wastewater systems.

The City of Longview, Texas, suffered damages during the March 28-29 and May 16, 1989, floods. Both events were recognized by Federal and State Disaster Relief Teams as being major events. In July, 1989, the City recommended that a flood protection plan be initiated to develop reconnaissance-level plans for flood protection in Federal Emergency Management Agency (FEMA) designated areas. A study was begun in December 1989, to develop this plan with Texas Water Development Board grant fund assistance.

City of Kilgore. The City of Kilgore receives water from Longview and withdraws ground water from the Carrizo-Wilcox Aquifer in Smith County. The City is a member of the Little Cypress Utility District. Using the developable supply of Little Cypress Reservoir in conjunction with an effective water conservation program, the City is anticipated to be able to meet its future water needs through the year 2040.

Kilgore operates a 3 MGD wastewater treatment facility. The City has immediate needs to upgrade this plant to conform to new permit standards.

City of Marshall. The City of Marshall has rights to flows in the Big Cypress Creek. The City's diversion point is in the backwater of Caddo Lake and when the flow in the creek is low, the diversion is from Caddo Lake. The City is a member of the Little Cypress Utility District. By using the District's Little Cypress Reservoir in conjunction with an effective water conservation program, the City is anticipated to be able to meet its future water needs through 2040.

Marshall completed major rehabilitation and expansion on its 5.91 MGD wastewater treatment facility in 1988. These improvements have dramatically improved performance.

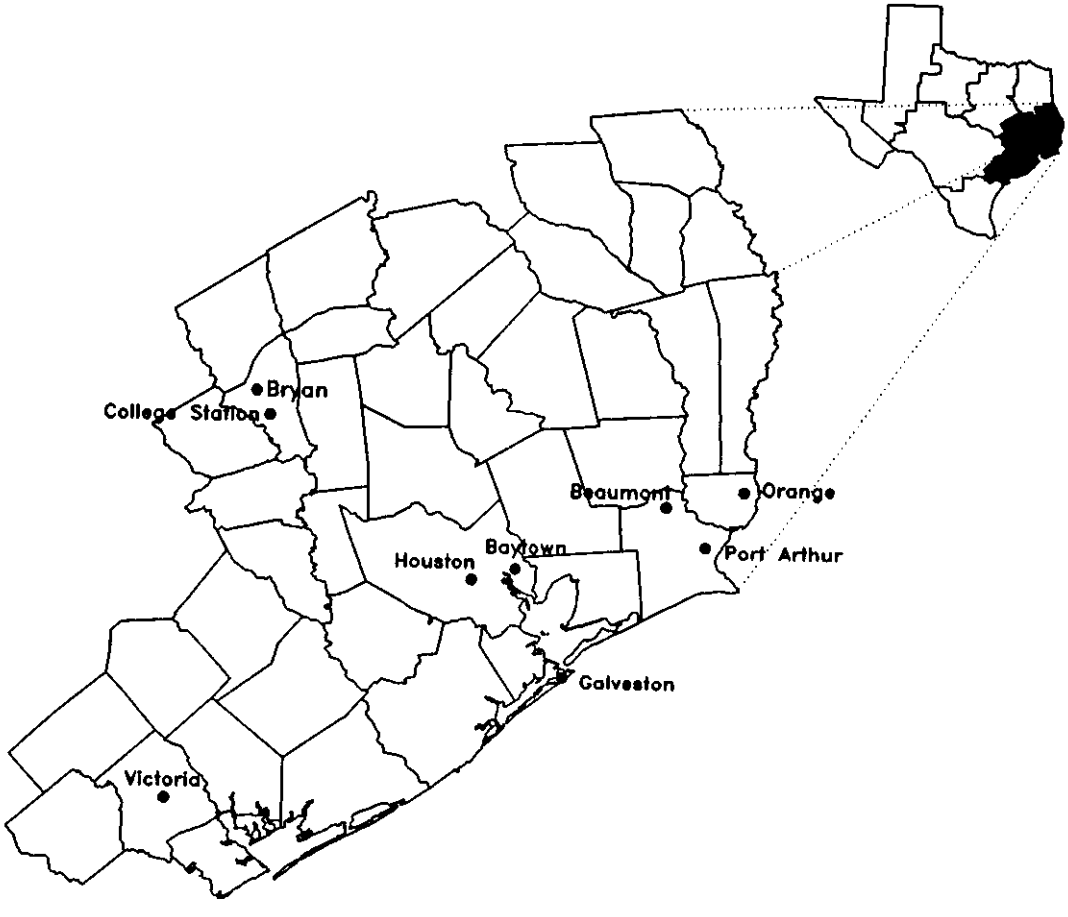
City of Texarkana. The City's water needs are supplied by Lake Texarkana. The City also serves as a regional supplier by serving De Kalb, Nash, New Boston, and Maud. Using the present supplies in Lake Wright Patman in conjunction with an effective water conservation program, the City is anticipated to be able to meet its future water needs and the other cities it supplies through the year 2040.

Texarkana operates three wastewater treatment facilities: the 11.7 MGD New Regional South Plant, the 2 MGD Wagner Creek Plant that serves two adjoining cities, and a smaller plant serving an isolated subdivision. The South Plant became operational in 1988 and is in the final stages of construction to meet advanced treatment requirements. The City has identified additional needs for treatment facility modifications and improvements.

City of Paris. The city's water needs are met from Lakes Crook and Pat Mayes. The City is anticipated to be able to meet it's future water needs through the year 2040 by using the City's present supplies in conjunction with an effective water conservation program.

The City of Paris completed additions to its 7.25 MGD wastewater treatment facility in 1987. Infiltration/inflow and deterioration in components of the collection system are continuing problems.

SOUTHEAST TEXAS AND UPPER GULF COAST REGION



CHARACTERISTICS OF THE REGION
THAT AFFECT WATER SUPPLY AND DEMAND

POPULATION :	1990	5.028 million
	2000	5.987 million
	2010	6.970 million
	2020	7.949 million
	2030	9.000 million
	2040	9.756 million

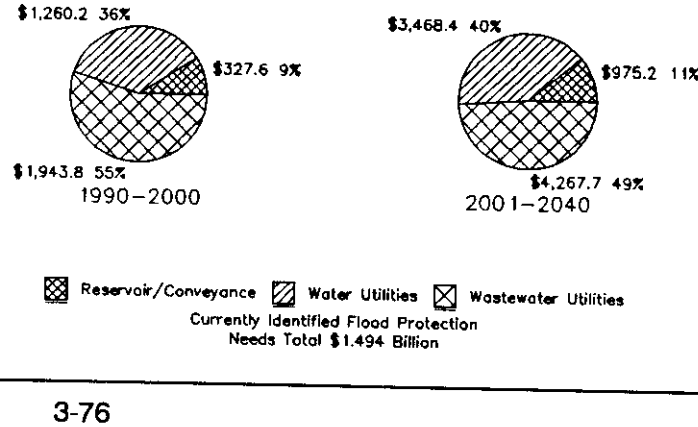
MAJOR ECONOMIC SECTORS: Manufacturing, Mineral Production, Finance, Services, Retail and Wholesale Trade, Agriculture, Tourism, Commercial Shipping and Fishing, and Government

AVERAGE ANNUAL PRECIPITATION: 32 to 56 inches

ANNUAL NET EVAPORATION RATE: 45 inches

PHYSIOGRAPHY: Densely wooded rolling to hilly surface in East Texas transcending to grassy, flat coastal plains

COST DISTRIBUTION OF IDENTIFIED
REGIONAL WATER-RELATED PUBLIC FACILITY NEEDS
(mill. $)



Currently Identified Flood Protection
Needs Total $1.494 Billion

SOUTHEAST TEXAS AND UPPER GULF COAST REGION

Regional Description. The Southeast Texas and Upper Gulf Coast Region consists of 41 counties located in the lower reaches of the San Antonio, Guadalupe, Colorado, Brazos, Trinity, Lavaca, Sabine, and Neches River Basins and seven Coastal Basins along the Gulf Coast. In 1980, the population of the region totaled 4.9 million people, with Harris, Jefferson, Galveston, and Brazoria counties accounting for nearly 68 percent of the regional population.

Currently, the regional population is estimated at about 5.0 million residents. By the year 2040, population of the region is projected to range between 8.3 and 9.8 million residents. Major population centers of the region include the cities of Houston, Beaumont, Pasadena, Baytown, Port Arthur, Bryan, Galveston, Victoria, College Station, and Texas City.

Currently, annual water use in the region is about 3,350,000 acre-feet. Water used for irrigation purposes accounts for almost 45 percent of the total regional water use, with municipal and manufacturing water use accounting for about 50 percent of regional use.

The current regional water use pattern is anticipated to change over the 50-year planning period as municipal and manufacturing water requirements are projected to account for over 65 percent of the regional water requirements by the year 2040. Water requirements for municipal and manufacturing purposes are projected to nearly double by the year 2040 above current water use levels. With implementation of water conservation programs and practices, annual savings in municipal water use are projected to reach about 88,900 acre-feet by the year 2000, increasing further to over 290,000 acre-feet by 2040.

Regional Water-related Problems and Needs. Land-surface subsidence and saltwater encroachment have resulted from overdevelopment of ground-water supplies. Saltwater intrusion during periods of low flow in the Brazos, Neches, and Trinity Rivers has the potential for contaminating the freshwater supplies at existing intake facilities.

Smaller cities are anticipated to have problems relating to surface water availability, treatment, conveyance, and storage facilities. Navigation facilities, channel maintenance, dredge-spoil disposal, and bay and estuary protection require continuing management programs. Water quality problems require a continuous monitoring and water quality management program. In many local areas, storm-surge flooding and drainage continues to be a serious problem.

The percent distribution of the estimated $12.243 billion in projected total costs for identified water and wastewater infrastructure in the Southeast Texas and Upper Gulf Coast Region over the 50-year planning period is shown in the inset box at left. Approximately $3.532 billion would be required in the first ten years and an estimated $8.711 billion in the remaining 40 years of the planning period.

Local Water-related Problems and Needs. A brief narrative of the Board's evaluation of the water resources situation of major urban areas and large utility suppliers in the Southeast Texas and Upper Gulf Coast Region is described below. Additional information may be obtained from the Board's files.

Trinity River Authority. The Trinity River Authority has 30 percent of the diversion rights in Lake Livingston. The Authority has over 376,000 acre-feet per year of supply available. Lake Livingston supplies raw water to three water treatment systems, including the Huntsville, Trinity County, and Livingston regional water supply systems.

However some of the overall Lake Livingston water supply is used for the prevention of salt water intrusion that affects the operation of the major irrigation canal systems and the Coastal Water Authority. With the development of the salt water barrier, the water used for intrusion control could be used to meet other water needs in the region.

Brazos River Authority. The Brazos River Authority owns or operates 12 major reservoirs on the Brazos River and its tributaries. Supplies from Lakes Possum Kingdom, Limestone, Granbury, Belton, Somerville, Stillhouse Hollow, and Granger are used to meet needs in the region. With the construction of Lake Bosque, operated as a system with the enlarge Lake

Waco, the Authority will increase its system-wide supplies.

The BRA also will need to develop the Allen's Creek Reservoir site to meet anticipated surface water needs due to the conversion from dependance on Gulf Coast Aquifer ground water in the areas of Fort Bend and western Harris counties. If projected water conservation savings are not realized, the South Bend project should be added to the Authority's water supply sources.

The Brazos River Authority operates a 6.5 MGD regional wastewater treatment plant serving the City of Sugarland, several water districts, and various area industries. Growth in this regional wastewater system will be accommodated by flow transfer to a second facility owned and operated by Fort Bend County MUD #13.

Lower Colorado River Authority. The Lower Colorado River Authority (LCRA) owns and operates six lakes in the Colorado Basin. The LCRA also operates two irrigation supply companies in the lower part of the Colorado Basin. Lakes Buchanan and Travis are capable of delivering over 445,000 acre-feet per year of firm water supply.

The LCRA, through its management plan, has estimated that it has the ability to deliver up to one million acre-feet per year of water supply on a interruptable basis. The LCRA delivers water supplies for irrigation, manufacturing, and cooling water for steam-electric power generation in the region.

Lavaca-Navidad River Authority. The Lavaca-Navidad River Authority owns 43 percent of Lake Texana and has indicated a willingness to purchase the remaining share of the reservoir from the Board to meet anticipated manufacturing needs in the region. Excess supplies that remain in the project could be used to meet needs in the Corpus Christi or San Antonio areas.

Sabine River Authority. The Sabine River Authority (SRA) is the owner of three reservoirs in the Sabine River Basin. The SRA has entered into an agreement with the adjacent San Jacinto River Authority to supply them up to 672,000 acre-feet per year from the Toledo Bend Reservoir. The two river authorities have planned to make use of already constructed canal systems where possible to deliver water to the San Jacinto Basin. This major conveyance project would entail working agreements with various canal agencies and river authorities. The ultimate plan for the conveyance system would be designed reduce environmental impacts associated with the routing of the facilities.

Lower Neches Valley Authority. The Authority provides water to the cities and industrial complexes of Beaumont and Port Arthur and Jefferson County from the Sam Rayburn Reservoir. Construction of a permanent salt water barrier on the lower Neches River would protect the urban supplies from sea water intrusion.

Coastal Water Authority. The Coastal Water Authority is the surface water supply agency for the City of Houston. The Authority provides raw water to the industrial complexes on the Houston Ship Channel as well as to the City's water treatment plant. The Authority will need to increase the delivery capacity of the system and should be the receiver of water from Toledo Bend.

Harris-Galveston Coastal Subsidence District: The Harris-Galveston Coastal Subsidence District regulates the amount of ground water removed from the Gulf Coast Aquifer in the Houston-Galveston area. The District has developed a conversion plan to convert areas currently using ground water to surface water before the year 2010.

The conversion plan will increase the need for additional surface water supplies within the region. These water supplies are anticipated to be met from supplies available to the Houston metropolitan area and supplies imported from the Sabine and Brazos river basins.

San Jacinto River Authority. The San Jacinto River Authority owns Lake Conroe and surface water rights within the basin. The Authority provides water to Houston and the Baytown area. The Authority has entered into agreement to purchase up to 672,000 acre-feet per year from the Sabine River Authority. It is anticipated that the water will be used to meet supply needs in the Houston metropolitan area.

A proposed local project, Spring Creek Lake, could provide supplies for municipal uses to Montgomery County. If the Toledo Bend diversion or diversions from the Trinity River prove infeasible, the Lake Creek project could provide for alternative supplies to the Authority's service area.

The San Jacinto River Authority operates a regional wastewater system serving the districts comprising the Woodlands development in southern Montgomery County. Designed for 6 MGD, the principal treatment facility in this system requires upgrading to meet more stringent treatment standards, and if population projections prove accurate, will require expansion to meet future demand.

City of Houston. Municipal water needs for the City of Houston are anticipated to almost double over the next 50 years. An active water conservation program can reduce the needs to about 705,000 acre-feet per year. These needs will require the development of additional diversion facilities from the Trinity Basin and the use of water supplies from the Sabine Basin. It is anticipated that the City will continue to be a regional supplier, and in fact, will expand its involvement as a supplier.

Houston has approximately 40 operational wastewater treatment facilities ranging in size from the 200 MGD 69th Street Complex to facilities with less than 1 MGD capacity. The City has an aggressive capital improvements plan to deal with problems of collection system integrity, sludge transfer (to regional processing facilities), treatment plant adequacy, and the need for greater regionalization. Solving existing problems and providing for future needs will be a significant undertaking.

Houston has approximately $1 billion in flood project needs, identified in a number of studies conducted over the past 10 years. Major watersheds which are subject to flooding include Clear Creek, Sims Bayou, Upper White Oak Bayou, Buffalo Bayou, and Cypress Creek. A comprehensive regional flood protection study of the Clear Creek watershed was begun in April 1989, with Board grant assistance. The need for a comprehensive plan to include consideration of various land use regulations, channel enlargements and rectifications, and regional detention have been identified by all drainage entities within the region.

City of Galveston. The City of Galveston receives water from the City of Houston through the Galveston County Water Authority. With the development of additional transmission facilities by the City of Houston and the importation of Toledo Bend water, in conjunction with an effective water conservation program, the City is expected to meet its future water needs through the year 2040.

The City is served by two principal wastewater facilities, the 10 MGD Main Treatment Plant and the 3.75 MGD Airport Plant. The City also operates the Park Plant and two subdivision plants on the west end. Current needs revolve around upgrading specific processes at the Main and Airport facilities and maintaining an aging collection system.

Galveston's major flood hazards relate to tropical storms and hurricanes in the Gulf of Mexico. A September 1987 Corps of Engineers high flood hazard area study, partially sponsored by the Board, recommended numerous flood damage protection measures along the Gulf Of Mexico, including evacuations, floodproofing for shallow-flooding, enforced zoning, and installation of flood warning systems. A drainage study of McCloud Bayou watershed also identified several million dollars worth of needed improvements.

City of Baytown. The City uses ground water and surface water purchased from the Baytown Area Water Authority. The Authority is supplied water from Lake Livingston by the Coastal Water Authority (CWA). CWA is expected to increase it's available supplies by importing water from the Sabine Basin. The City is anticipated to be able to meet it's future water needs through the year 2040 by using CWA present supplies and additional supplies imported by CWA in conjunction with an effective water conservation program.

Baytown employs three wastewater treatment facilities with more than 100 MGD of capacity. Major renovations were completed on the 6.2 MGD Central District plant in 1988. The City has identified a need to rehabilitate its aging, infiltration-prone collection system. Projected population increases may require expansion and upgrading at both the 3 MGD East District Plant and the 1.32 MGD West District Plant.

Cities of Bryan-College Station. The cities of Bryan and College Station currently withdraw water from the Carrizo-Wilcox Aquifer. It is anticipated that the cities will continue to make withdrawals from the Aquifer; however, additional water supplies will be needed. It is anticipated that these additional needs could be met from ground-water resources. Using the cities' existing ground-water supplies and additional well field supplies, in conjunction with an effective water conservation program, they are expected to meet their future water needs through the year 2040.

Bryan is served by three wastewater treatment plants: the 6.4 MGD Burton Creek Plant, the 4 MGD Still Creek Plant, and the 0.75 MGD Turkey Creek Plant. Bryan's most immediate task will be to meet upgraded treatment requirements for these facilities.

A May 1986 Corps of Engineers study of Burton Creek identified approximately $2.5 million worth of needed improvements to bridges, flood walls, and other structures. Additional watersheds are also due for study by the City.

The City of Bryan has also completed a flood protection planning study of the Briar Creek watershed finding over $3 million in damages during large flooding events. The City is planning to study all nine of its watersheds over the next several years.

Beaumont-Port Arthur. The Beaumont-Port Arthur area chiefly depends on supplies from Lake Sam Rayburn and the Neches River. The City of Beaumont also withdraws ground water from the Gulf Coast Aquifer. Using the present supply sources available to the cities, with construction of a salt water barrier on the lower Neches River, and with an effective water conservation program, Beaumont and Port Arthur are expected to meet their future water needs through 2040.

Beaumont is served by a single wastewater treatment plant on Hillebrandt Bayou. The City proposes to meet advanced treatment requirements at this 30 MGD plant with an artificial wetland system. In recent years, the City also "separated," at considerable expense, the state's last combined sanitary/storm sewer system.

The City of Port Arthur employs four treatment facilities, two serving the main portion of the City, one serving Pleasure Island, and one serving the Sabine Pass area. The principal plants, the 9.2 MGD Main Plant and the 2.6 MGD Port Acres Plant, have recently been equipped with peak flow handling capabilities. Maintaining collection systems in dynamic soil conditions is a continuing problem for both cities.

Two recently completed floodplain studies for this area identified a number of potential structural improvement measures in the Hillebrandt Bayou drainage basin and recommended flood damage prevention measures including restrictive zoning, no future development, and floodproofing for shallow flooding. A flood protection planning study by the Hardin County WCID No. 1 and the Board was completed in June 1990 and recommended various structural improvements to alleviate local flooding problems, including channel, levee and interior drainage improvements and outfall drainage improvements.

A flood protection study was also completed in May 1990 with Board grant funding assistance by the Port Arthur and Jefferson County Drainage District No. 7. Recommended actions included construction of pumping facilities with detention storage, a levee system, and channelization improvements.

City of Orange. The City of Orange presently withdraws water from the Gulf Coast Aquifer and the Sabine River. Using the present supply sources available to the City, in conjunction with an effective water conservation program, Orange is expected to meet its future water needs through 2040.

The City of Orange operates a 2.9 MGD plant (Jackson Street) and a 0.18 MGD plant serving the Bancroft area. The City has identified projects to expand treatment for high flow periods and to correct problems in the collection system.

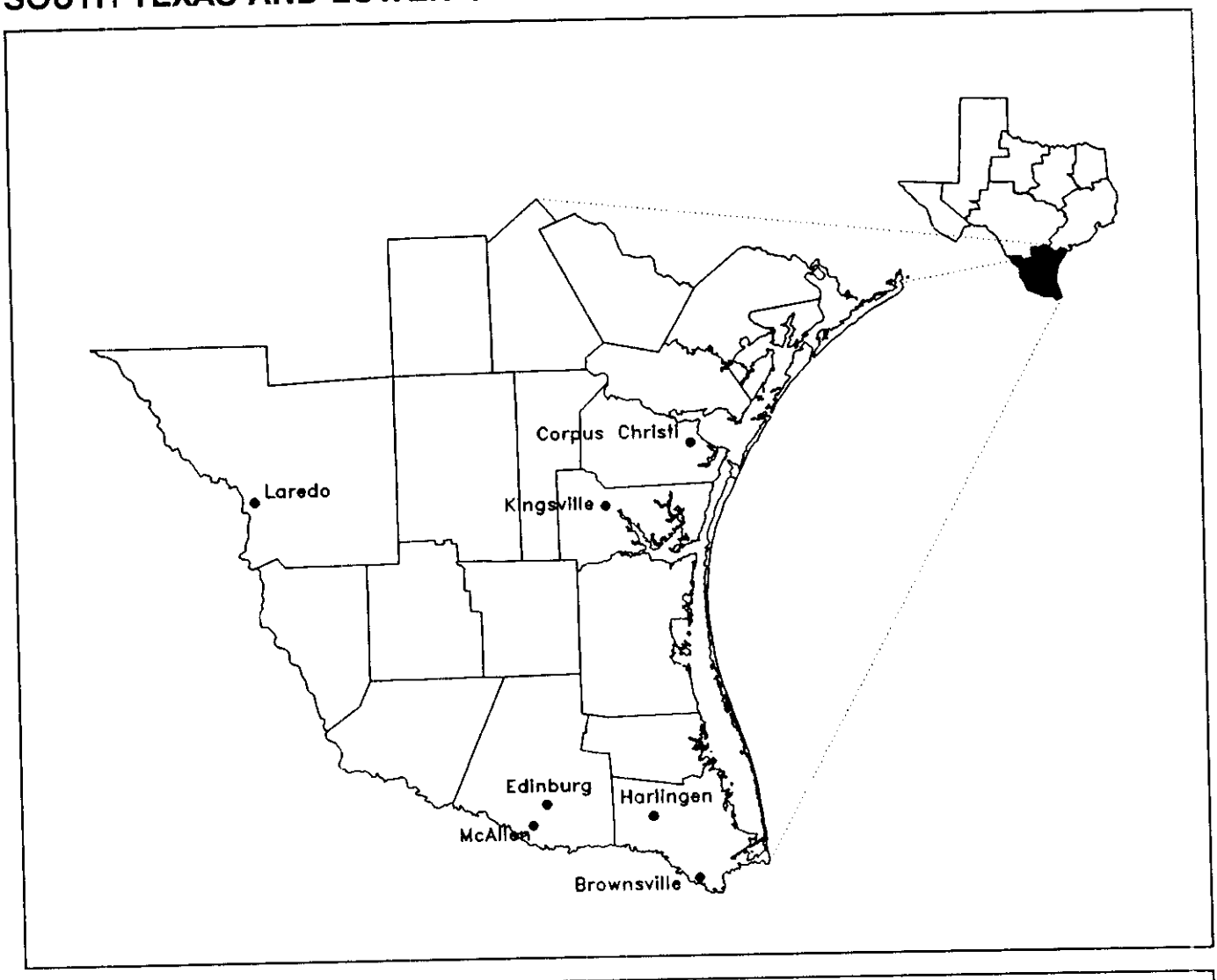
Two recent floodplain studies have identified modest structural improvements along Swifts Slough and recommended flood damage protection measures in the Sabine River Basin, consisting of an area-wide flood control plan, clearing and grubbing, evacuation planning, restrictions prohibiting future development, and other measures.

City of Victoria. The City of Victoria withdraws its water supply from the Gulf Coast Aquifer. If the aquifer is unable to provide enough water supply, excess supplies in Lake Texana could be used to meet any supply shortage. However, present estimates indicate that the City's ground-water supplies, in conjunction with an effective water conservation program, are expected to meet Victoria's future water needs through the year 2030. Studies conducted by the City indicate that a blend of ground water and surface water will be needed by the year 2040.

The City of Victoria operates its own wastewater collection system. It contracts for treatment at two plants operated by the Guadalupe-Blanco River Authority.

Two recent flood protection studies identified over $5 million in structural improvements needed for raising the levee to provide 100-year flood protection. The studies also identified numerous non-structural flood damage prevention measures which should be implemented. The U.S. Army Corps of Engineers is also initiating feasibility phase studies of the levee flood protection problems in Victoria. The City of Victoria and the Board are providing funding participation in this study.

SOUTH TEXAS AND LOWER GULF COAST REGION



CHARACTERISTICS OF THE REGION
THAT AFFECT WATER SUPPLY AND DEMAND

POPULATION :	1990	1.456 million
	2000	1.807 million
	2010	2.224 million
	2020	2.758 million
	2030	3.351 million
	2040	3.701 million

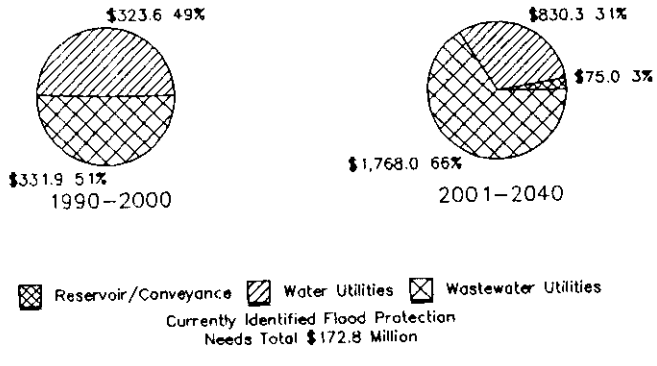
MAJOR ECONOMIC SECTORS: Agriculture, Agribusiness, Manufacturing, Retail and Wholesale Trade, Services, Mineral Production, Tourism, and International Trade

AVERAGE ANNUAL PRECIPITATION: 21 to 40 inches

ANNUAL NET EVAPORATION RATE: 53 inches

PHYSIOGRAPHY: Grassy, brushy flat coastal plains

COST DISTRIBUTION OF IDENTIFIED
REGIONAL WATER-RELATED PUBLIC FACILITY NEEDS
(mill. $)



Currently Identified Flood Protection
Needs Total $172.8 Million

SOUTH TEXAS AND LOWER GULF COAST REGION

Regional Description. The South Texas and Lower Gulf Coast Region consists of 19 counties located in portions of the Rio Grande and Nueces River Basins, and the San Antonio-Nueces and Nueces-Rio Grande coastal basins. The 1980 regional population totaled 1.13 million people, with the counties of Hidalgo, Nueces, and Cameron accounting for about 68 percent of the total population. The regional population is currently estimated at about 1.36 million people. By 2040, the regional population is projected to range between 3.1 and 3.7 million residents. Major population centers within the region are the cities of Corpus Christi, Laredo, Brownsville, McAllen, Harlingen, Edinburg, Mission, Kingsville, Pharr, and Weslaco.

Currently, annual water use within the region is about 1,341,700 acre-feet. Water used for irrigation purposes accounts for more than 78 percent of the region's water use. The current regional water use pattern is anticipated to change over the 50-year period as municipal and manufacturing water use are projected to account for about 42 percent of the total regional water demand by 2040, with irrigation water requirements accounting for only 55 percent. The substantial growth in municipal water requirements is reflective of the anticipated rapid growth in population for the Rio Grande Valley. With implementation of water conservation programs and practices, annual municipal water use savings are projected to reach about 29,300 acre-feet by the year 2000, increasing to over 117,800 acre-feet by 2040.

Regional Water-related Problems and Needs. The Region has insufficient quantities of surface and ground water to meet the needs for all water using purposes in areas of the Lower Valley. Surface water quality in the region is generally good, but low dissolved oxygen occurs in some stream segments during summer months. Surface water supplies are practically all developed and committed. Over the years, small unincorporated subdivisions have developed along the Rio Grande with little or no water supply and wastewater treatment facilities to meet their daily needs. Soil salinity and drainage problems are present locally and flooding and storm-surge problems exist in many areas of the region. Navigation facilities, channel maintenance, dredge-spoil disposal, and bay and estuary protection require continuous monitoring and management programs.

The percent distribution of the estimated $3.329 billion in projected total costs for identified water and wastewater infrastructure in the South Texas and Lower Gulf Coast Region over the 50-year planning period is shown in the inset box at left. Approximately $656 million would be required in the first ten years and an estimated $2.673 billion in the remaining 40 years of the planning period.

Local Water-related Problems and Needs. A brief narrative of the Board's evaluation of the water resources situation of major urban areas and large utility suppliers in the South Texas and Lower Gulf Coast Region is described below. Additional information may be obtained from the Board's files.

South Texas Water Authority. The South Texas Water Authority (STWA) supplies water to Kingsville, Agua Dulce, Riviera Beach, and several other small towns. The Authority purchases water from the City of Corpus Christi. With the ability to purchase additional water supplies from Corpus Christi, the Authority is expected to meet its future water needs through the year 2040.

Nueces River Authority. The Nueces River Authority is the regional planning and management agency in the area. The Authority owns part of Choke Canyon Reservoir which supplies water to the City of Corpus Christi. Using present estimates of available supplies, the Authority should have adequate water to meet the Basin's future needs.

Watermaster Operations. Both Amistad and Falcon Reservoirs are operated by the International Boundary and Water Commission as a system for flood-control and water supply purposes. The United States' share of conservation storage in the projects is administered by the Texas Water Commission (TWC), currently under provisions of the "Lower Rio Grande Valley Water Case." According to the judgment rendered in the court case, water in the two reservoirs is to be allocated to Class A irrigation, Class B irrigation, and municipal, industrial, and domestic use. A watermaster employed by the TWC is responsible for allocating the amount of water which can be diverted by each A and B Class irrigator and for supervising each use of water. In addition to individual industrial plants which have independent water systems, there are over 75 purveyors of

municipal, domestic, and light-industrial water supplies within the four-county valley region. These purveyors must purchase Class A and B irrigation rights to increase their water supplies.

A similar Watermaster operation has been recently implemented for the San Antonio, Guadalupe, and Nueces river basins and the three adjacent coastal basins. The newly created effort is in the process of full development and implementation of its programs. As distinct from the Rio Grande Watermasters, the Watermaster in the South Texas region has no similar large storage reservoirs with which to more closely monitor releases and use of rights.

City of Corpus Christi. The City of Corpus Christi owns Lakes Corpus Christi and part of Choke Canyon. These two lakes are estimated to supply over 252,000 acre-feet per year. Preliminary studies indicate that environmental releases could reduce the supplies of these lakes to 231,000. The City provides water to South Texas Water Authority, the Alice Water Authority, Beeville, Port Aransas, Rockport, Mathis, Three Rivers, San Patricio County MWD No. 1, Lamar Pennisula, and the industrial complexes on the Corpus Christi Channel. Also, Nueces County WCID #1 in nearby Robstown is a separate permit holder for water rights on the Nueces River. It is anticipated that with uncertain dependable yields from the City of Corpus Christi's two existing reservoirs and mandated environmental releases from those projects, the City would need additional supplies before 2040. These water supply needs could be partially met with an expanded water reuse program (if allowed by the TWC) or fully met by obtaining additional supplies from the existing Lake Texana and potentially from a future Palmetto Bend II reservoir. Associated construction of major conveyance facilities would be required.

The City of Corpus Christi operates seven wastewater treatment facilities. The City's Westside Plant is currently being expanded to 6 MGD. Additional plant expansion is planned to handle flow diverted from the Broadway STP (10 MGD) service area. The aging Broadway treatment plant will need extensive renovation. Other plants; Oso (16.2 MGD), Allison (5 MGD), Flour Bluff (3 MGD), and Whitecap (0.5 MGD), need expansion and/or modification. The City has an extensive sewer rehabilitation program. The City also plans to build a new Southside plant sometime around the year 2000 to handle anticipated population growth in this area.

Brownsville-Harlingen. The cities of Brownsville and Harlingen use water withdrawn from the Rio Grande which is charged against their water rights in Falcon Reservoir. The cities will probably exceed their diversion permits by 2010. At such time, the cities will need to purchase additional water rights. By 2030 the Cities will need additional supplies which can be met from a channel dam below Brownsville. The project is estimated to be able to supply about 85,000 acre-feet per year, subject to State permitting determination. With the development of the channel dam and the purchase of water rights, in conjunction with an effective water conservation program, the cities are expected to meet their future water needs through 2040.

Brownsville utilizes two major wastewater treatment facilities. The 7.8 MGD South Plant is the City's original facility. The newer Robindale Plant (5 MGD) will be expanded to an intermediate size of 10 MGD, and will be the site for virtually all needed expansion in the foreseeable future. Harlingen also operates two major treatment facilities. The City's number two facility is being upgraded and expanded from 3.5 MGD to 5 MGD in a treatment/reuse scheme with participation by a local industry. Plant Number 1 may require expansion in the future and a third facility may be constructed to handle anticipated growth.

Brownsville has severe flooding problems which were described in a master drainage plan prepared under a Board grant in August 1987. This report identified an immediate improvements program costing over $48 million, involving numerous channel widening projects and re-alignments, along with construction of detention storage and other structural modifications.

McAllen-Edinburg. The cities of McAllen and Edinburg use water from the Rio Grande backed up by storage in Falcon Reservoir. In order to meet future water requirements the cities will need to purchase additional irrigation water rights. By purchasing additional water rights, in conjunction with an effective water conservation program, the cities are expected to meet their future water needs through the year 2040.

McAllen operates two wastewater treatment plants. Plant Number 2, the Main Plant, is a 10 MGD extended aeration facility. More stringent treatment standards may necessitate construction of another plant. Plant Number 3, the 4 MGD North Plant, was constructed in 1987 with federal grant assistance.

This site will handle expected growth in the McAllen area. Edinburg is served by a single 4.5 MGD treatment facility that is actually four autonomous units operating in parallel. Population growth is expected to necessitate expansion sometime after 2000.

City of Kingsville. The City of Kingsville withdraws water from the Gulf Coast Aquifer and is supplied from Lake Corpus Christi by the STWA. It is anticipated that the present supplies to the City, in conjunction with an effective water conservation program, could meet the City's future water needs through 2040.

Kingsville is served by two wastewater treatment plants: the 3 MGD North facility and the 1.0 MGD South plant. Population growth is not expected to require expansion until after year 2010.

The City of Kingsville has constructed local drainage improvements using a Community Development Block Grant to alleviate local drainage problems and flooding problems along Tranquitas Creek.

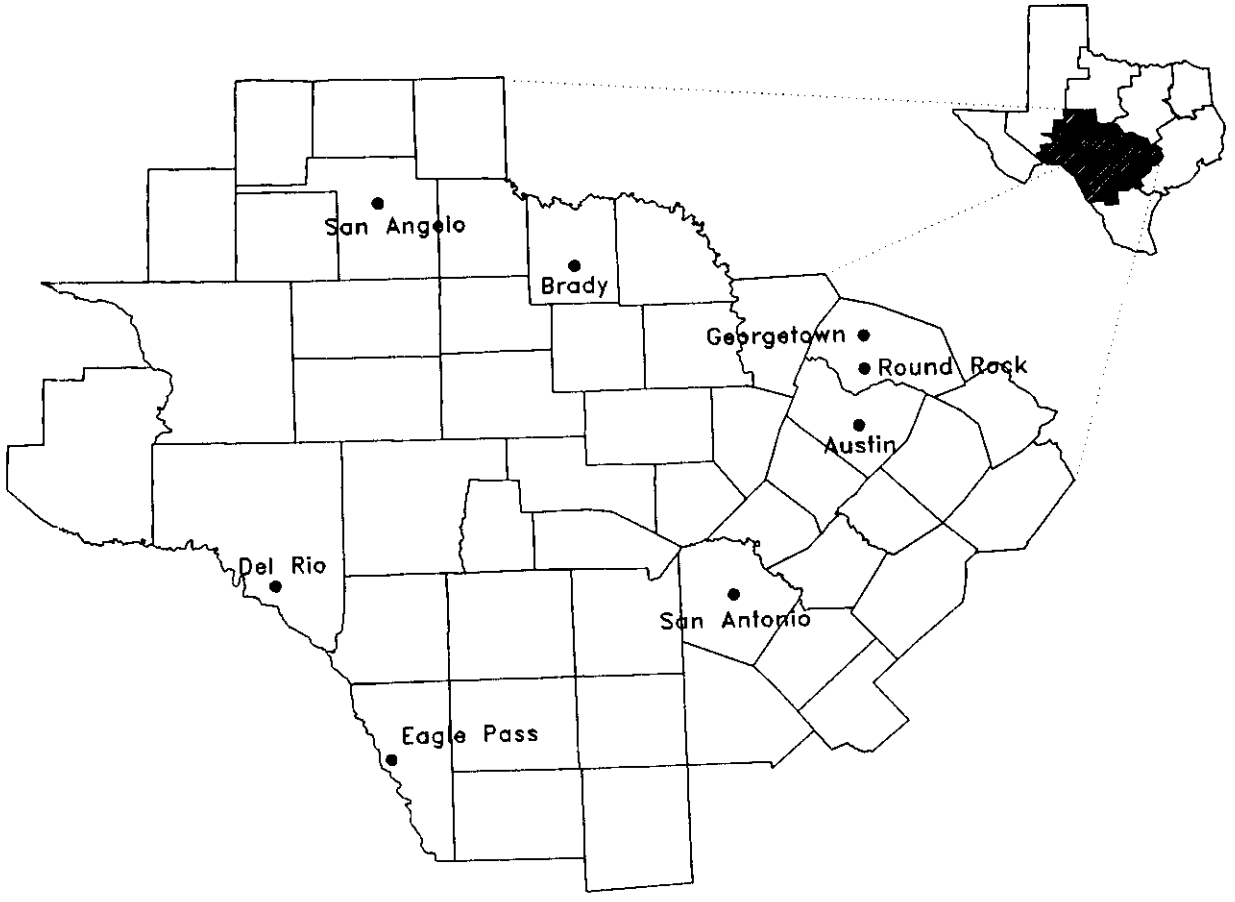
City of Laredo. The City of Laredo is supplied with water withdrawn from the Rio Grande which is charged against its water rights in Amistad Reservoir. The City will need to purchase additional irrigation water rights to meet its future needs. With the purchase of additional rights, in conjunction with an effective water conservation program, the City is expected to meet its future water needs through 2040.

Laredo operates three wastewater treatment facilities: the 14 MGD Zacate Creek Plant, the 3 MGD Southside Plant, and the 0.426 MGD North Laredo Reclamation Plant. The City has a project underway to expand the North system to 0.926 MGD. The City intends to provide for anticipated future growth at the Southside Plant in 3 MGD increments.

An on-going Corps of Engineers flood control study has identified over $15 million worth of needed flood protection improvements, consisting of a detention reservoir and an embankment in the upper Zacate Creek drainage basin.

Rural Areas. Many unincorporated subdivisions characterized by depressed economic conditions, including limited water supplies and limited wastewater facilities, exist within localized areas of the region,typically along the Rio Grande and predominately within Hidalgo, Cameron, and Willacy counties. Recognizing the existing and impending economic and health problems of these areas, the Texas Legislature has directed the Texas Water Development Board to provide financial and technical assistance for construction of facilities to provide suitable water supply and wastewater treatment for these areas.

SOUTH CENTRAL TEXAS REGION



CHARACTERISTICS OF THE REGION
THAT AFFECT WATER SUPPLY AND DEMAND

POPULATION :	1990	2.866 million
	2000	3.619 million
	2010	4.348 million
	2020	5.226 million
	2030	6.422 million
	2040	7.136 million

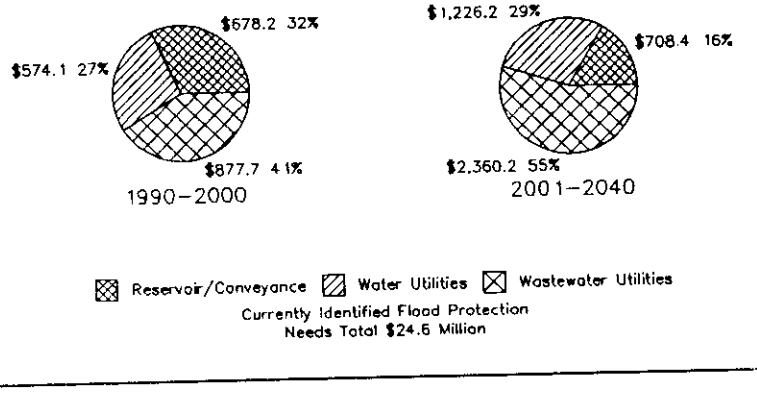
MAJOR ECONOMIC SECTORS: Manufacturing, Retail and Wholesale Trades, Agriculture, Agri-business, Mineral Production, Government, and Tourism

AVERAGE ANNUAL PRECIPITATION: 14 to 42 inches

ANNUAL NET EVAPORATION RATE: 17 inches

PHYSIOGRAPHY: Rolling, grassy prairies in the west transcending to hilly, wooded hill country in the central and eastern portions of the region

COST DISTRIBUTION OF IDENTIFIED
REGIONAL WATER-RELATED PUBLIC FACILITY NEEDS
(mill. $)



SOUTH CENTRAL TEXAS REGION

Regional Description. The South Central Region consists of 48 counties located in portions of the Nueces, San Antonio, Colorado, and Guadalupe river basins. In 1980, the regional population totaled 2.16 million people, with the counties of Bexar and Travis accounting for more than 65 percent of the total regional population. Currently, the regional population is estimated at 2.69 million residents. By the year 2040, population of the region is projected to range between 5.6 and 7.1 million residents. Major population centers of the region are the cities of San Antonio, Austin, San Angelo, Del Rio, San Marcos, New Braunfels, Round Rock, Eagle Pass, Seguin, and Kerrville.

Currently, total annual water use of the region is estimated at about 1,197,700 acre-feet. The two major water use categories of the region are irrigation and municipal water use, accounting for almost 46 percent and 42 percent of total water use, respectively. The current regional water use pattern is expected to change over the 50-year planning period as municipal water requirements are projected to become the major water demand category of the region, accounting for almost 62 percent of total water use by the year 2040. With implementation of water conservation programs and practices, savings of annual municipal water use are projected to reach over 63,000 acre-feet by the year 2000, increasing to nearly 250,000 acre-feet by the year 2040. The reduction in irrigation water requirements is reflective of expected implementation of more efficient irrigation equipment and management practices.

Regional Water-related Problems and Needs. Rapid growth of urban areas is straining existing water supply and waste-disposal facilities and subjecting many citizens to the threat of flooding. Pumping from the Carrizo-Wilcox Aquifer in the Winter Garden area has lowered water levels more than 400 feet since 1930. Poor quality water is encroaching into the aquifer in this area and pumping costs may soon render this aquifer an uneconomical source of irrigation water. The upper Colorado River Basin has serious water quality problems due to inflow of saline ground water. Another recurring problem throughout the region is localized flash flooding from intense storms.

Continued protection of the Edwards (Balcones Fault Zone) Aquifer from over-drafting and pollution is essential. Development of alternative water supplies is needed to firm up municipal supplies and reduce reliance on the Edwards (Balcones Fault Zone) Aquifer in critical drought periods. Increased use of surface water would also assist in maintaining the ecosystems and recreational opportunities of Leona, San Pedro, San Antonio, Hueco, Comal, and San Marcos Springs, and the base flow of streams to the south of the aquifer. The Guadalupe and San Antonio river basins have potential surface water projects that could be developed.

The San Antonio area is and will continue to be highly dependent upon ground water for water supply. Water from the Edwards (Balcones Fault Zone) Aquifer is used extensively for municipal, manufacturing, irrigation, domestic and livestock watering purposes in the area. The San Antonio and south Travis/north Hays County segments of the aquifer are supervised by the Edwards Underground Water District and the Barton Spings-Edwards Aquifer Conservation District, respectively. The Districts have varying powers and revenue gathering capabilities. The segment of the Edwards north of the Colorado River has no underground water district supervision.

The Aquifer is essential to the present and future economic well-being of the San Antonio area, since it is the sole water supply for over one million people and their economy. During the severe drought of 1947-1956, water levels in the Edwards Aquifer declined significantly and spring flows from the Aquifer were seriously reduced. To assure an adequate water supply to meet all of the future needs of the area requires "wise" management of the supplies available from the Edwards Aquifer and the integration of supplemental supplies into the overall water supply. Such a plan would also require that the area would not suffer social hardships and no sector of the economy would be deprived of an adequate economical water supply.

The Board has developed a computerized mathematical representation of the Edwards Aquifer, the purpose of which is to simulate the response of water levels in the Aquifer to pumpage and recharge for any given time period. The Board has analyzed various pumping and recharge schemes. The

principal conclusions drawn from the analysis are that if total pumpage from the aquifer is limited to a little over 424,000 acre-feet per year for irrigation, municipal, and manufacturing and the assumed recharge sequence occurs, San Marcos Springs can be expected to continue flowing. Extreme water level declines will not occur and the potential saline water intrusion will be greatly reduced. However, studies underway indicate that the pumpage limit may not provide adequate protection.

Any management policy for the Edwards Aquifer which imposes a maximum limit upon annual pumpage will necessitate at some future time the curtailment of additional development by some users of the aquifer. Such aquifer-wide limitations must involve all of Bexar and surrounding counties. If economic growth in Bexar County is not to be inhibited by water shortages, then alternative water supplies must be developed from the most economically available resources. The multiplicity of agencies, cities, and water users in the county should work together to develop the water supply alternative that will fit the needs of the county.

The percent distribution of the estimated $6.425 billion in projected total costs for identified water and wastewater infrastructure in the South Central Texas Region over the 50-year planning period is shown in the inset box located at the introduction to this region's discussion. Approximately $2.130 billion would be required in the first ten years and an estimated $4.295 billion in the remaining 40 years of the planning period.

Local Water-related Problems and Needs. A brief narrative of the Board's evaluation of the water resources situation of major urban areas and large utility suppliers in the South Central Texas Region is described below. Additional data may be obtained from the Board's files.

Lower Colorado River Authority. The Lower Colorado River Authority (LCRA) owns and operates six lakes in the Colorado Basin. The LCRA also operates two irrigation supply companies in the lower basin. Lakes Buchanan and Travis are capable of delivering over 445,000 acre-feet per year of firm supply. The LCRA, through its management plan, has estimated that it has the ability to deliver up to 1,000,000 acre-feet per year of supply on an interruptable basis. It is anticipated that the LCRA will be able to satisfy the needs of its service area through 2040 if the Board's projected conservation savings can be attained. If projected municipal water conservation savings are not realized, the Shaws Bend Reservoir project will be needed.

Brazos River Authority. The Brazos River Authority has the Lake Georgetown and Granger water supply reservoirs in the region and plans to build a pipeline to transfer water from Lake Stillhouse Hollow to Lake Georgetown to supply future needs in the area.

Guadalupe-Blanco River Authority. The Guadalupe-Blanco River Authority operates Canyon Reservoir and several small hydro-electric reservoirs on the Guadalupe River. The Authority provides water supply and wastewater treatment services to several communities within the Guadalupe Basin. The Authority also provides water supply to Port Lavaca and rural areas of Calhoun County. The Authority is permitted to divert over 50,000 acre-feet per year from Canyon Reservoir. Supplies available to the Authority plus developable supplies in the Lindenau and Cuero Reservoir projects will allow the Authority to meet the future needs of its service area and needs in the San Antonio area.

San Antonio River Authority. The San Antonio River Authority provides flood protection and wastewater treatment plants in the San Antonio River Basin. The Authority could be the local sponsor for the recommended Goliad Reservoir and potentially the Cibolo Reservoir if the Board's projected conservation savings or other sources of supply for the San Antonio area are not realized.

The Authority operates wastewater systems in two San Antonio River tributary watersheds. The Salatrillo Creek system serves the City of Converse and portions of Universal City and Live Oak. Projected population growth will require expansion of this 3.52 MGD treatment facility. The Martinez Creek system is a two-plant system. The 2.21 MGD Martinez I plant may require modification to meet new discharge requirements. The downstream Martinez II plant will be the site of any needed expansion.

Canyon Regional Water Authority. The Canyon Regional Water Authority is the planning and development agency for nearly all of Guadalupe County, a large portion of Bexar County and portions of Hays, Wilson, and Comal counties. The Authority's supply source is the Edwards-Balcones Aquifer. The Authority is encouraging development of alternative

sources for users not located directly over the aquifer. It is predicted that needs in the Authority's area will be met by the Guadalupe-Blanco River Authority and supplies developed for the San Antonio area.

Colorado River Municipal Water District. The Colorado River Municipal Water District (CRMWD) has surface water supplies in Lake J.B. Thomas, Lake E.V. Spence, the recently constructed O.H. Ivie Reservoir, and well fields in Martin, Ector, Ward, Howard, Glasscock, and Scurry counties. The CRMWD also provides water quality enhancement by diverting low stream flows of high salinity to side storage. These diversion points are located on the Colorado River near Colorado City, on Beals Creek near Big Spring, and on Three and Four Mile Lakes.

Additionally, the CRMWD will begin construction on a $7 million water quality enhancement project in Mitchell County during 1990. Member cities of the District include Odessa, Snyder, and Big Spring. Over the 50-year planning period, the District is not expected to add new sources of surface water supply but will provide transmission facilities related to the new O.H. Ivie Reservoir project. The District will develop additional ground-water supplies during the planning period and will continue its policy of conjunctive use of ground- and surface water assets.

City of San Antonio. The City of San Antonio is the largest city in the region. San Antonio's sole water-supply source is the Edwards Aquifer. The City is developing sorely-needed surface water supplies at the Applewhite Reservoir site on the Medina River. The project could develop an average of over 50,000 acre-feet per year. However, the supply during a drought could fall to about 7,900 acre-feet per year. The City is evaluating other supply alternatives including additional surface water development of Lindenau and Cuero Reservoirs in the Guadalupe Basin and Goliad and Cibolo reservoirs in the San Antonio Basin, other potential new reservoirs or ground-water sources, reuse of wastewater, purchase of already developed supplies, or various combinations of these alternatives.

The Board is recommending the development of the Lindenau, Cuero, and Goliad reservoir sites, in conjunction with a reuse program. If projected municipal water conservation savings are not realized, the Cibolo Reservoir will be needed, along with increased reuse of water. These water supplies could be used to meet the needs of the City and other entities that draw water from the Edwards Aquifer. These entities would have to comply with any management plan developed for the Edwards Aquifer.

San Antonio operates three large regional treatment plants. Construction on the new 83 MGD Dos Rios plant was completed in 1987. The 36 MGD Salado Creek and 35 MGD Leon Creek plants have also undergone recent modernization/expansion projects. The City has a number of projects identified within each service area. Projected population growth will require expansion either at these sites or at one or more new sites. The City is investigating alternative "water factory" or reuse proposals.

A 1986 Corps of Engineers high flood hazard area study, partially sponsored by the Board, recommended numerous damage prevention measures, including the development of an area-wide flood control plan, flood control levees, and enforced zoning in the 100-year floodplain along the San Antonio River, including 61 small creeks running through San Antonio. A 1989 study by Bexar County and the Board developed flood protection plans for reaches of Leon, Cibolo, and Salado Creek in Bexar County. Recommended improvements include railroad bridge replacement, expanded flood warning, and some channelization improvements.

Bexar-Medina-Atascosa WCID No. 1. The District is the owner of one of the oldest surface water projects in the State that is still used for water supply. Lake Medina is used for municipal supply and to supply irrigation water to farmers in Bexar, Medina, and Atascosa counties. The Lake and diversion facilities also recharges the Edwards-Balcones Aquifer. It is estimated that the Lake recharges as much as 50,000 acre-feet per year to the aquifer. Depending on its operation, the supply available from Lake Medina can range from zero up to 60,000 acre-feet per year. The District is authorized to sell water for municipal use, and the Water Plan recommends that as surplus water occurs, the District converts the surplus to municipal supplies for conjunctive use with ground water in the Bandera County region and for use to supplement other supplies in Bexar County.

Springhills Water Management District. The District's water supply situation is generally representative of problems experienced by a larger region to the north of the San Antonio metropolitan area where primary dependence on ground water for municipal supplies, water level declines in the Trinity-Plateau Aquifer, and

diminished supplies, especially during hot weather conditions, have resulted in the designation of the Hill Country Critical [ground water] Area. The critical area report recommends additional conjunctive use of surface and ground water to meet the future water supply needs of the area. The District feels that this could be accomplished through acquisition of water rights or supplies from nearby Lake Medina. The Board has also just approved a regional water supply planning grant study to the Bandera County area to further address the water supply problems and potential alternative solutions.

City of Austin. The City of Austin uses supplies from the Colorado River and Lake Austin. Additional supplies are available through the LCRA. Using the supplies available from the river and the supplies from LCRA in conjunction with an effective water conservation program, the City is anticipated to be able to meet its future supply needs through 2040.

Austin has nearly completed a major round of construction on its three major wastewater treatment facilities. They include: Walnut Creek (60 MGD), South Austin Regional (40 MGD), and Govalle (20 MGD). A fourth facility, Hornsby Bend, receives sludge via pipelines from all plants and is in the process of major upgrading. The City has identified a number of major interceptor projects needed to serve areas in the south and west. The City also participates in a regional system in the Brushy Creek watershed.

The City of Austin has experienced serious flooding over the last 20 years, and several Corps of Engineers studies have identified improvements needed in the Walnut Creek, Shoal Creek, and Onion Creek watersheds. Additional flood damage prevention measures were recommended in a Corps of Engineers high flood hazard study conducted in September 1985, including flood control levees, enforced zoning, clearing and grubbing, and areawide flood planning.

Round Rock-Georgetown. The cities of Round Rock and Georgetown withdraw water from the Edwards Aquifer and from Lake Georgetown. The cities have contracted for over 22,400 acre-feet per year of supply from Stillhouse Hollow Reservoir, owned by the BRA. It is anticipated that the cities will need additional supplies in the future. Additional water supplies may be available through the LCRA. With the development of transmission facilities from Stillhouse Hollow and possibly Lake Travis, in conjunction with an effective water conservation program, the cities are expected to meet their future water needs through 2040.

The City of Round Rock utilizes two wastewater treatment facilities with a total of 5.5 MGD capacity. The City's East Plant (2.5 MGD) will be the site of a major regional plant operated by Brushy Creek WCID #1, with the City of Austin and other entities participating. Georgetown operates a 2.5 MGD facility. Its location on the Edwards Aquifer precludes expansion at that site. The City is proposing a second facility at Dove Springs to the east.

Several floodplain management studies conducted over the past decade have identified over $6 million in recommended structural improvements in the Lake Creek drainage basin, along with needed protection measures, including flood control levees, and no development and zoning enforcement in portions of the Lake Creek and Brushy Creek watersheds.

City of San Angelo. The City of San Angelo receives water from Twin Buttes Reservoir and from Colorado River Municipal Water District. The City also has a well field in McCulloch County. However, the well field has not been developed due to conflicts with the Hickory UWCD over the transfer of water outside of the district. The City has purchased 16.54 percent of the water supply from the recently completed O.H. Ivie Reservoir. With the completion of transmission facilities from the Reservoir, additional supplies of about 18,600 acre-feet per year will be available to the City. With the existing City supply and planned transmission facilities, in conjunction with an effective water conservation program, the City is expected to meet its future water needs through the year 2040.

San Angelo's 7.36 MGD "Sewer Farm" wastewater treatment facility is overloaded. The City intends to finance expansion to 13.2 MGD through the State Water Pollution Control Revolving Loan Fund. The existing and proposed facilities utilize mechanical treatment with irrigation. The City also operates two small facilities in the vicinity of Lake Nasworthy.

A 1985 Corps of Engineers study, partially sponsored by the Board, recommended structural and non-structural flood damage prevention measures in Brentwood Park, East Angelo Draw, North Concho River, Red Arroyo, and South Concho river basins, consisting of zoning and detention reservoirs.

City of Brady. Brady presently receives water from the Hickory Aquifer; however, the water supply from its wells does not meet the Safe Drinking Water Act standards for radioactivity. It is recommended that the City convert to a surface water source. The City has diversion permits for almost 3,100 acre-feet per year from Lake Brady. Using Lake Brady, in conjunction with an effective water conservation program, the City is expected to meet its future water needs through 2040.

Brady plans to replace its existing 1 MGD wastewater treatment facility with a 1.1 MGD facility capable of advanced treatment. A small facility at the City's airport will be abandoned, and flow will be diverted to the new plant as part of this project.

City of Del Rio. The City of Del Rio receives water from local springs and wells into the Edwards-Trinity (Plateau) Aquifer. The springs are estimated to be able to supply about 11,000 acre-feet per year. Using the supplies from the springs supplemented with additional ground water, in conjunction with an effective water conservation program, the City is expected to meet its future water needs through the year 2040.

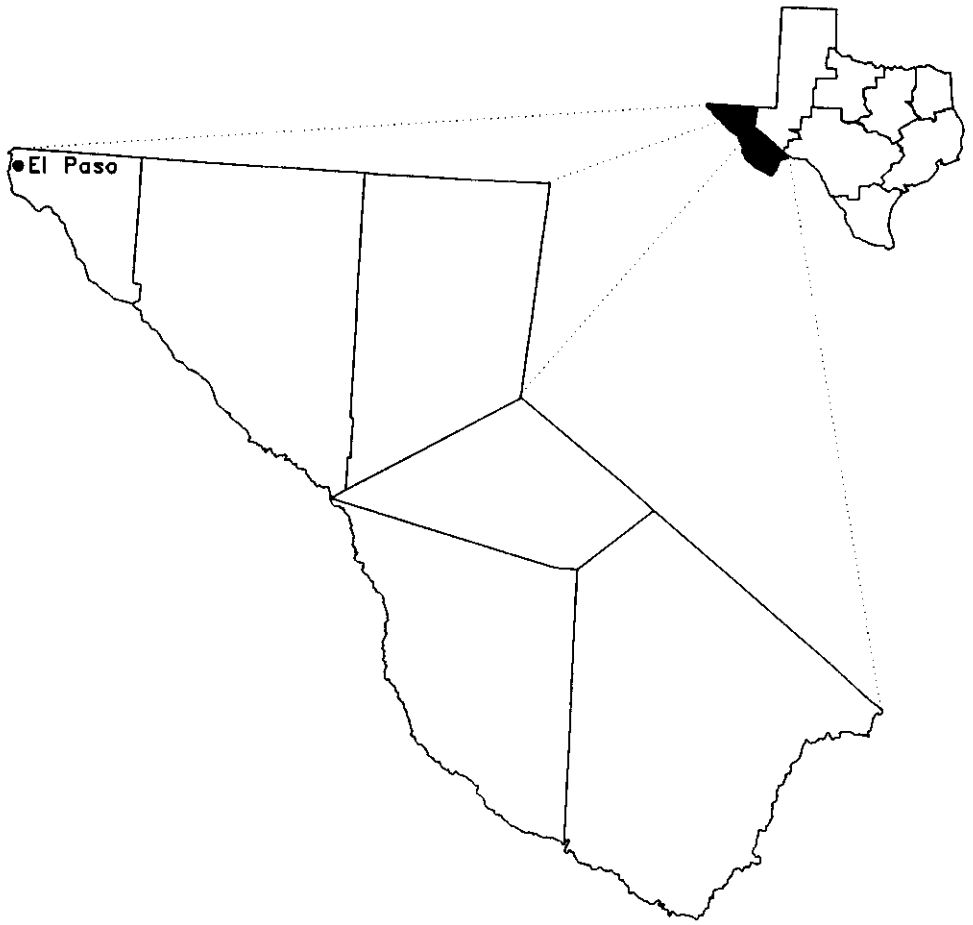
The City of Del Rio operates three wastewater treatment plants: Silver Lake (1.76 MGD), Round Mountain (0.63 MGD), and San Felipe (1.63 MGD). The City is expanding the Silver Lake plant to 2.76 MGD. The City also intends to expand the San Felipe plant to 3.8 MGD and divert the Round Mountain service area to it, thereby reducing the number of facilities to two.

Corps of Engineers high flood hazard area studies, conducted in 1985 and 1989, recommended flood damage prevention measures in the Calaveras, Cantu, and San Felipe Creek basins, and additional streams in the Del Rio area. These measures consist mainly of evacuation plans, flood control levees, and a ban on future development in portions of the floodplain.

City of Eagle Pass. The City of Eagle Pass uses water supplies from the Rio Grande backed with storage in Amistad Reservoir. Using the present supplies, in conjunction with an effective water conservation program, the City is expected to meet its future water needs through the year 2040.

Eagle Pass operates one 3 MGD wastewater treatment facility. Population growth and the addition of previously unserved subdivisions to the system are expected to require expansion at this site.

UPPER RIO GRANDE AND FAR WEST TEXAS REGION



CHARACTERISTICS OF THE REGION
THAT AFFECT WATER SUPPLY AND DEMAND

POPULATION :	1990	0.634 million
	2000	0.796 million
	2010	0.977 million
	2020	1.192 million
	2030	1.407 million
	2040	1.528 million

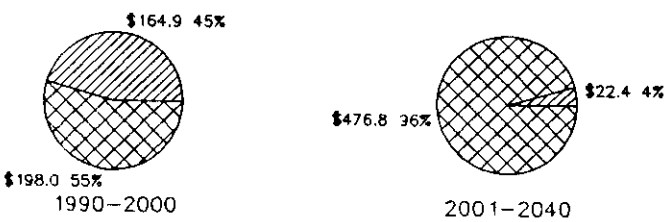
MAJOR ECONOMIC SECTORS: Mineral Production, Manufacturing, Retail and Wholesale Trades, Agriculture, Tourism, and International Trade

AVERAGE ANNUAL PRECIPITATION: 8 to 18 inches

ANNUAL NET EVAPORATION RATE: 66 inches

PHYSIOGRAPHY: Flat to rolling to mountainous, sparsely-vegetated desert with relatively flat, floodplain areas adjacent to the Rio Grande

COST DISTRIBUTION OF IDENTIFIED
REGIONAL WATER-RELATED PUBLIC FACILITY NEEDS
(mill. $)



UPPER RIO GRANDE AND FAR WEST TEXAS REGION

Regional Description. The Upper Rio Grande and Far West Texas Region is comprised of six counties located entirely in the upper reaches of Rio Grande River Basin. In 1980, the population of the region totaled 500,400 residents with more than 95 percent of the population located in El Paso County. Currently, the regional population is estimated at 594,500. By the year 2040, population of the region is projected to be between 1.27 and 1.53 million residents. The population centers of the region are the cities of El Paso, Alpine, Fabens, Canutillo, Anthony, Van Horn, Marfa, Clint, Fort Davis, Sierra Blanca, and the Fort Bliss military installation.

Total annual water use within the region is estimated at almost 463,400 acre-feet, of which more than 68 percent is used for irrigation purposes.

This current water use pattern is expected to change over the 50-year planning period as municipal and manufacturing water requirements are projected to increase substantially while irrigation water requirements are projected to remain relatively stable. Due to the anticipated rapid growth in population associated with El Paso County, regional municipal water requirements are projected to more than double over the planning period. With implementation of conservation programs and practices, annual savings in municipal water use are projected to reach more than 13,500 acre-feet by the year 2000 and increase to nearly 50,900 acre-feet by the year 2040.

Regional Water-related Problems and Needs. Water supplies are limited throughout the region. The surface water and ground-water supplies of the Region are shared by Texas, New Mexico, and Mexico. During the past 30 years, the Rio Grande delivered only 65 percent of the water needed for the El Paso irrigation area. Ground water from the Hueco Bolson deposits is the primary source of municipal and industrial supply; however, the Bolson is being "mined," resulting in encroachment of saline water from adjacent saline water-bearing sands. High salinity in surface water supplies, due to frequent low flows and increased salinity of municipal and agricultural return flows have been detrimental to crops and cropland. Over the years small unincorporated subdivisions have developed with little or no water supply and wastewater facilities to meet their daily water-related needs.

The percent distribution of the estimated $862 million in projected total costs for identified water and wastewater infrastructure in the Upper Rio Grande and Far West Texas Region over the 50-year planning period is shown in the inset box at left. Approximately $363 million would be required in the first ten years and an estimated $499 million in the remaining 40 years of the planning period.

Local Water-related Problems and Needs. A brief narrative of the Board's evaluation of the water resources situation of major urban areas and large utility suppliers in the Upper Rio Grande and Far West Texas Region is described below. Additional information may be obtained from the Board's files.

The City of El Paso. The City is currently supplied water from the Hueco and Mesilla Bolson and the Rio Grande Project of New Mexico and Texas. Water from the Rio Grande Project is stored in Elephant Butte Reservoir in New Mexico, with annual releases determined by the Bureau of Reclamation. Texas' share of these releases has averaged about 126,000 acre-feet per year with El Paso receiving about 13,500 acre-feet. The City also has a reuse-recharge project that could recharge approximately 10,000 acre-feet to the aquifer. The project is currently recharging up to 6,700 acre-feet. In the future, reuse could increase supplies by about 35,000 acre-feet. The City's water conservation program should extend the available water supplies; however, without additional water supply sources, the City could anticipate a deficit of over 70,000 acre-feet by the year 2040. A water management plan, being conducted for the City service area by the El Paso Public Service Board, indicates slightly higher conservation savings and a slightly lower or no deficit forecast (depending upon the availability of ground water from nearby Bolson deposits) than does the Board's forecast.

El Paso's wastewater treatment needs are handled within four large service areas. The 27.7 MGD Haskell Street Plant serves central areas of the City including Fort Bliss. The 20 MGD Socorro Plant, serving the southern portion of the City, will be replaced by the new 39 MGD Southeast plant which is near completion. The 10 MGD Fred Hervey Reclamation Plant serves northeastern sections of the

City. This plant treats wastewater to drinking water standards, then pumps it into the Hueco Bolson Aquifer for reuse. The 6.4 MGD Quarry Plant treats wastewater from the northwest section of the City. Current plans are to expand this facility to 15 MGD.

El Paso Lower Valley Water District Authority. The approximate 200-square-mile District was created to address the pressing water and wastewater service needs of the relatively poor incorporated and unincorporated areas south of the City of El Paso. In the few years since its creation, efforts by the District, the City of El Paso, local irrigation districts, and citizens groups have resulted in a cooperative program to address area water and wastewater needs. This program has allowed the District to purchase an existing, limited-service-area water system from the City of El Paso. The system was previously used to service the northwestern portion of the District. Using this existing system and other improvements, expanded water service could be developed within the District. The City of El Paso's Socorro wastewater treatment plant would be made available for use by the District in the Lower Valley on completion of the El Paso's Southeast treatment plant.

Rural Areas. Many unincorporated subdivisions characterized by depressed economic conditions, including limited water supplies and limited wastewater facilities, exist within localized areas of the region, typically along the Rio Grande and predominately in El Paso County. Recognizing the existing and impending economic and health problems of these areas, the Texas Legislature has directed the Texas Water Development Board to provide financial and technical assistance for construction of facilities to provide suitable water supply and wastewater treatment for these areas. Due to the limited water supplies for meeting the water needs of rural areas throughout El Paso County, a shortage of approximately 13,900 acre-feet per year is anticipated by the year 2040. An effective water conservation program should be implemented for extending available supplies through the year 2030.